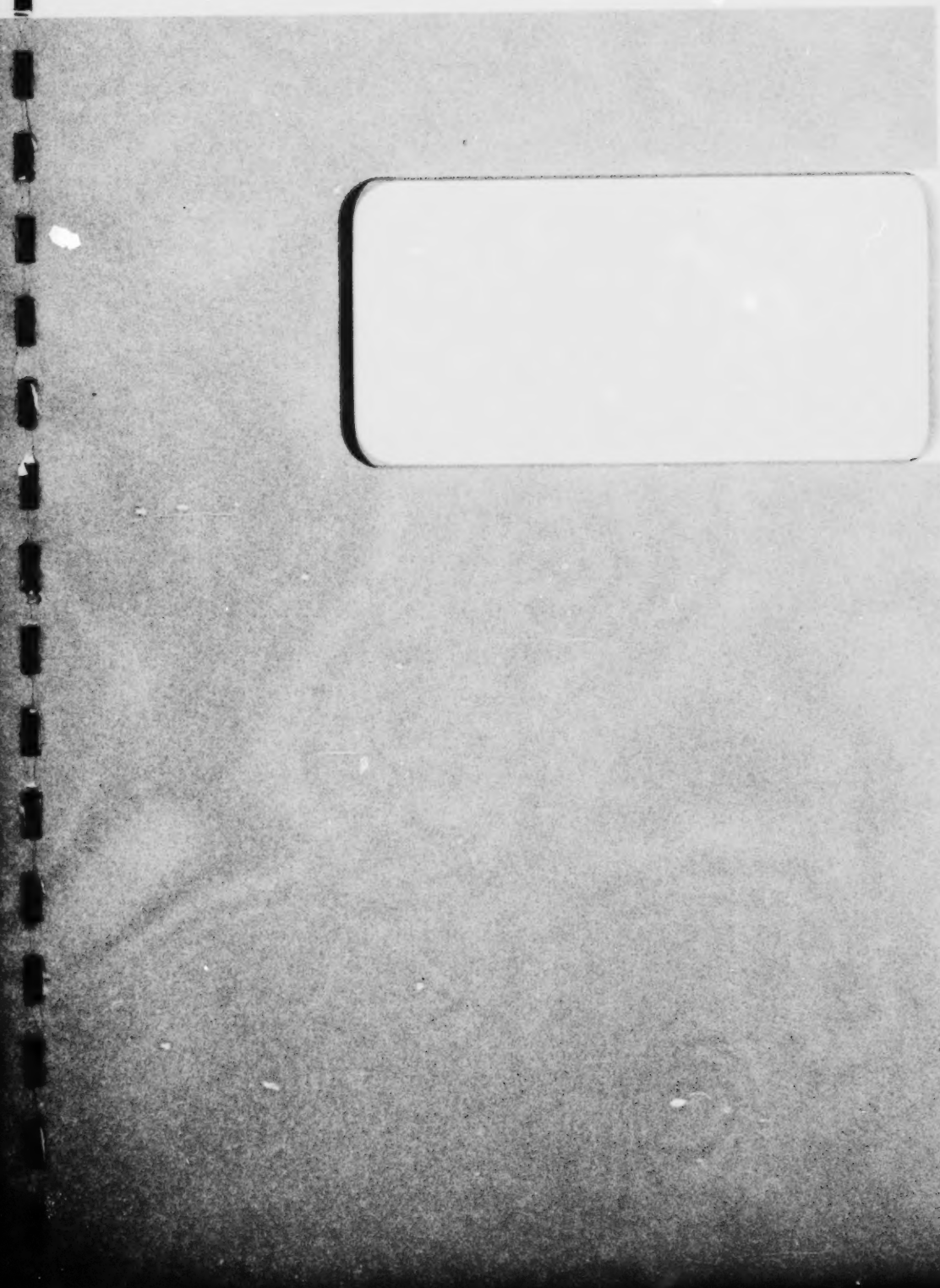
B1

Environmental Assessment

Waste Treatment Facility

OWMC
Ontario Waste Management Corporation

A provincial crown corporation.



WASTE QUANTITIES STUDY

August, 1982

Proctor & Redfern Limited
Weston Designers-Consultant
Ontario Research Foundation

The Proctor & Redfern Group

Consulting Engineers and Planners
45 Green Belt Drive
Don Mills, Ontario, Canada M3C 3K3
Telephone (416) 445-3600 Telex 06-986173

82 08 13

Mr. E. H. Schmidt
Project Director
Ontario Waste Management Corporation
60 Bloor Street West
Suite 707
Toronto, Ontario
M4W 3B8

Dear Sir

Waste Quantities Study

We are pleased to present the final report of the Waste Quantities Study.

This report documents the types, quantities and industrial and geographic sources of liquid industrial waste and hazardous waste generated in Ontario in 1981.

Members of the Project Team found this study to be a most interesting and challenging assignment.

Yours very truly

Proctor & Redfern Limited

W. D. Goodings
Vice-President

WDG:tg
Encl.

TABLE OF CONTENTS

Page

LETTER OF TRANSMITTAL

SUMMARY

1.0 INTRODUCTION

1.1 Objectives 9
1.2 Study Overview 10
1.3 Report Format 12

2.0 STUDY BASIS

2.1 General. 13
2.2 Alternative Methodologies 13
2.3 Selected Methodology 14
2.4 Applicable Wastes 16
2.5 Waste Classification 18
2.6 Industry Classifications 20
2.7 The Waste Generation Model 21

3.0 DATA COLLECTION

3.1 General. 23
3.2 Waste Generation Factor Sources 23
3.3 Employment by Industry 24
3.4 Productivity Differentials 25
3.5 Production Employee Ratios 26
3.6 Technical Interview Program 26
3.7 Existing Treatment and Disposal Practices 28

TABLE OF CONTENTS

Page

4.0 GENERATOR INTERVIEWS

4.1 General. 33
4.2 Criteria for Generator Selection 33
4.3 Interview Format 35
4.4 Survey Results. 36

5.0 CATEGORIZATION OF WASTES

5.1 General. 37
5.2 Physical Characteristics 37
5.3 Waste Categories 38

6.0 ESTIMATE OF WASTE QUANTITIES

6.1 Introduction. 42
6.2 Data Accuracy 42
6.3 Waste Generated by Type 43
6.4 Waste Generated by Category 50
6.5 Waste Generated by Industry Type 53
6.6 Waste Generated by Municipal Area 53
6.7 Waste Quantity Projections 53

7.0 COMPARISON WITH OTHER SURVEYS

7.1 General. 62
7.2 Other Surveys 62

TABLE OF CONTENTS

Page

LIST OF TABLES

2-1	Compatability of Waste Classification Systems with Technical Project Requirements	19
3-1	Summary of Waybill Activity, April 1, 1981 to March 31, 1982	32
5-1	Waste Classification and Consolidation by Characteristics	39
6-1	Estimated Waste Generated by UCD Category	44
6-2	Estimated Waste Generated by Category and Physical Characteristic	51
6-3	Estimated Waste Generated by Physical and Chemical Nature	52
6-4	Estimated Waste Generated by Industry Type	54
6-5	Estimated Waste Generated by Geographic Area	57
7-1	Liquid Industrial Waste and/or Hazardous Waste Inventories Undertaken for Ontario	63
7-2	Comparison of Waste Estimates	66
7-3	Estimates of Waste Generated per Manufacturing Employee Derived from Reported Waste Generation Quantities	68

LIST OF FIGURES

2-1	Waste Generation Model - Matrix Example	22
6-1	Estimated Waste Generated by Industry Type	55
6-2	Locations of Municipal Areas	56
6-3	Estimated Waste Generated by Geographic Area	59
6-4	Future Trends in Waste Generation	61

LIST OF APPENDICES

A	Glossary of Terms
B	Bibliography
C	University of California at Davis (UCD) Waste Classification System
D	United States Department of Commerce - Standard Industrial Classifications (SIC)
E	Productivity Differentials - Canada and the United States
F	Licensed Receivers of Liquid Industrial Waste
G	Listing of Municipal Areas

SUMMARY

1. This report presents an inventory of hazardous liquid industrial waste and hazardous waste (hereinafter referred to as "waste") generated in Ontario in 1981. The data presented will be used by Ontario Waste Management Corporation (OWMC) in formulating plans to fulfill its mandate to provide facilities for recovery, treatment and/or safe disposal of such wastes.

2. Wastes are defined as those wastes requiring special treatment (i.e. they cannot be treated/disposed by facilities such as sewage treatment plants, municipal waste incinerators or in municipal landfills).

3. The main objectives of the study were:

   - to determine the types, quantities and sources of waste generated in Ontario

   - to identify facilities presently recovering, treating or disposing of waste generated in Ontario

   - to develop a data base that can be updated on a regular basis.

   These data can assist OWMC in identifying potential facility locations and designing facilities.

4. Approaches used in other North American jurisdictions for conducting an inventory of waste generation were reviewed and evaluated. It was decided to employ a "generation factor - ground truthing" approach that involved:

   - the analysis of data from other surveys to estimate waste generated on a per production employee basis

   - the development of a computer model using these "generation factors" and Ontario inventories of manufacturing employees

- conducting a survey of selected manufacturing establishments to ground-truth the generation factors and to make adjustments to the model where necessary

- predicting the quantity, type and source of waste generated in Ontario.

5. Total wastes are estimated to be 1.49 million tonnes. It is stressed that the estimates produced are for total wastes generated in Ontario in 1981. The data do not indicate the quantity of waste that will be received by OWMC facilities.

6. The wastes have been grouped into 14 categories (see Table S-1) based on similarity of physical and chemical characteristics. Of the 1.49 million tonnes of wastes, two categories contain the large proportion of total waste: approximately 38.5% (574,300 tonnes) are heavy metal solutions and residuals and a further 16.6% (246,800 tonnes) are sludges and inorganic residuals.

   Heavy metal solutions and residuals include spent plating or etching, rinse and less concentrated aqueous solutions, sludges from plating and etching lines and sludges from the treatment of solutions containing metals.

   Sludges and inorganic residuals include ash, foundry sands containing phenolics and spent catalyst.

7. The wastes are generated as solids, liquids and sludges and may be categorized chemically as either organic or inorganic. As shown in Table S-2, solids account for 24.8% of total wastes, liquids for 57.7% and sludges for 17.5%. Organics comprise 25% of total wastes, inorganics comprising 75%.

8. Significant industry generators of these wastes are shown in Table S-3. Approximately 52% of these wastes are generated by the primary metal industries, especially: blast furnaces and rolling mills; steel pipes and tubes; and smelting and refining of copper, lead, zinc and aluminum.

TABLE S-1

ESTIMATED WASTE GENERATED (1981)
BY WASTE CATEGORY AND PHYSICAL CHARACTERISTICS (TONNES)

WASTE CATEGORY	SOLID	LIQUID	SLUDGE	TOTAL	% OF TOTAL
Organic Sludges and Still Bottoms (no oil)	4,100	-	43,000	47,100	(3.2%)
Solvents and Organic Solutions	-	42,100	-	42,100	(2.8%)
Oils and Greases	-	51,000	-	51,000	(3.4%)
Oil/Water Mixtures	-	69,000	-	69,000	(4.6%)
Organic and Oily Residuals	17,300	169,400	34,700	221,400	(14.9%)
Heavy Metal Solutions and Residuals	-	514,700	59,600	574,300	(38.5%)
Miscellaneous Chemicals and Products	135,200	5,400	4,100	144,700	(9.7%)
Paint and Organic Residuals	11,700	-	38,300	50,000	(3.4%)
Aqueous Solutions with Organics	-	700	-	700	(0.0%)
Anion Complexes	-	7,400	27,400	34,800	(2.3%)
Sludges and Inorganic Residuals	192,400	-	54,400	246,800	(16.6%)
Pesticide and Herbicide Wastes	600	-	-	600	(<0.1%)
PCB Wastes	200	-	-	200	(<0.1%)
Clean-Up Residuals	7,600			7,600	(0.5%)
TOTAL	369,100	859,700	261,500	1,490,300	(100.0%)

TABLE S-2

ESTIMATED WASTE GENERATED BY
PHYSICAL AND CHEMICAL NATURE
(TONNES X 1,000)

	Chemical		
Physical	Organic	Inorganic	Total
- Solids	35.3	333.8	369.1
- Liquids	244.8	614.9	859.7
- Sludges	93.3	168.2	261.5
TOTAL	373.4	1,116.9	1,490.3

TABLE 5-3

ESTIMATED WASTE GENERATED BY INDUSTRY TYPE

(TONNES x 1000)

Industry \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oils & Greases	Oil/Water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals and Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges and Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	TOTAL %
Primary Metal Industries	*	0.9	3.2	2.9	182.7	278.7	36.6	2.1	-	26.3	233.3	-	-	-	766.7	51.5
Chemical Industries	11.9	6.2	6.0	3.9	2.8	68.2	27.0	8.5	0.7	3.2	5.2	0.5	-	2.8	146.9	9.9
Fabricated Metal Products	0.2	1.2	1.7	4.7	1.5	101.2	*	9.5	-	4.2	1.0	-	-	-	125.2	8.4
Machinery Except Electrical	0.5	10.7	1.7	48.5	12.6	28.0	0.7	3.2	-	-	0.2	-	*	0.1	106.2	7.1
Paper Products	-	2.3	0.4	-	-	4.5	72.8	2.7	-	-	-	-	-	-	82.7	5.5
Transportation Equipment	28.1	0.5	6.7	2.1	0.7	32.6	0.1	11.3	-	-	0.5	-	-	-	82.6	5.5
Petroleum	0.5	0.6	29.0	*	9.9	19.4	*	1.5	*	-	1.5	-	*	0.3	62.8	4.2
Printing	-	2.1	0.4	0.8	0.2	13.9	2.8	*	-	-	-	-	-	0.3	20.5	1.4
Stone, Glass, Concrete	-	8.3	*	0.3	0.1	6.5	-	0.9	-	-	3.4	-	-	-	19.5	1.3
Electrical Machinery	0.1	0.3	0.5	5.6	1.4	6.7	0.2	0.5	-	0.7	0.2	-	*	*	16.2	1.1
Rubber & Plastics	2.9	3.4	0.6	*	0.7	1.1	0.1	0.5	-	-	1.3	-	-	2.1	12.7	0.9
Non-Bldg. Construction	-	-	0.1	-	8.7	-	-	-	-	-	-	-	-	-	8.9	0.6
Misc. Manufacturing	*	0.8	*	-	-	4.6	0.1	1.9	-	0.4	-	-	-	-	7.8	0.5
Food Products	0.9	1.6	0.2	-	*	0.8	4.2	-	-	-	*	-	-	-	7.7	0.5
Furniture	-	0.1	0.1	-	-	1.2	*	4.8	-	-	-	-	-	-	6.2	0.4
Measuring Instruments	0.6	1.2	0.2	*	*	2.4	*	0.6	-	-	0.1	-	-	-	5.2	0.3
Leather Products	1.0	*	-	-	-	1.9	-	-	-	-	0.1	-	-	-	3.0	0.2
Textiles	0.2	0.9	0.2	*	*	*	-	*	-	-	-	-	-	-	1.4	0.1
Lumber & Wood	-	0.4	*	-	*	0.7	*	0.1	-	-	-	0.1	-	-	1.4	0.1
Apparel	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.1
Hospitals	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	2.0	0.1
Other	-	0.2	*	*	*	1.9	*	1.9	-	-	-	-	*	-	4.1	0.3
TOTAL	47.1	42.1	51.0	69.0	221.4	574.3	144.7	50.0	0.7	34.8	246.8	0.6	0.2*	7.6	1490.3	100.0

* Waste Quantities Less than 100 Tonnes
* PCB's Not Included in SIC Total
NOTE: Totals may not add due to rounding

A further 10% of the wastes are generated by the chemicals industry, including: industrial gases; plastic materials, synthetic resins; synthetic organic fibres; soaps and detergents; paints and varnishes; and pesticides and agricultural chemicals.

Other significant waste generating industries are fabricated metal products, machinery (except electrical), paper products, transportation equipment and petroleum.

9. The locations of the waste generators are shown in Table S-4. It can be observed that the Greater Toronto area (including Oakville, Mississauga, Brampton and Aurora) is the geographic source of approximately 31% of the wastes. Other notable sources are Hamilton (19.5%), Sault Ste. Marie (6.2%), Kitchener (5.2%) and Windsor (5.0%).

10. On the basis of waste generated per manufacturing employee, the results of this study are reasonably close to those of surveys carried out in other jurisdictions with similar industrial mixes.

11. OWMC, through its consultants, is attempting to determine (1) the present fate of the wastes estimated in this report and (2) the types and quantities of waste for which OWMC must design facilities.

TABLE S-4

ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA
(TONNES x 1000)

Municipality \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oil & Greases	Oil/Water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals & Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges and Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	TOTAL %
Hamilton	1.7	1.9	1.7	4.0	36.2	94.8	20.6	2.4	*	16.8	109.6	*	-	.3	290.0	19.5
Toronto	10.8	13.9	6.8	21.7	31.7	137.7	19.3	16.4	.2	2.4	12.1	.1	*	1.5	274.6	18.4
Sault Ste. Marie	*	.1	.4	.4	10.0	21.3	11.1	.4	-	6.2	43.0	*	-	*	92.9	6.2
Mississauga	1.9	4.2	3.6	6.6	19.9	34.5	4.3	3.7	*	.8	2.5	.1	*	.3	82.4	5.5
Kitchener	1.9	2.5	1.2	4.4	21.3	33.8	.6	1.8	.1	.6	6.8	*	-	2.4	77.5	5.2
Windsor	6.6	1.3	3.4	4.1	35.1	15.5	3.3	2.3	-	.2	1.9	*	-	.2	73.9	5.0
Welland	*	.7	.2	1.2	5.6	33.4	2.0	.4	*	1.8	14.5	*	-	.1	59.9	4.0
Brampton	1.5	1.6	.5	2.0	17.8	21.5	3.0	1.3	.1	.2	2.1	*	-	.2	51.8	3.5
Sarnia	.5	1.3	16.5	.5	6.3	18.3	.7	.8	.1	.6	1.6	.1	-	.9	48.2	3.2
St. Catharines	1.6	1.1	.7	2.1	3.3	11.9	13.5	1.7	*	.3	8.6	*	-	*	44.8	3.0
Oshawa	8.6	1.4	.8	1.9	2.9	12.5	1.4	2.5	*	.6	3.8	*	-	.2	36.8	2.5
Aurora	.5	.8	2.5	2.0	1.3	19.0	.8	1.3	*	.2	.8	*	-	.1	29.5	2.0
Thunder Bay	*	.1	.1	.3	.3	3.5	23.5	.8	*	.1	.5	*	-	*	29.2	2.0
London	.3	1.0	2.4	2.0	2.4	14.1	1.3	1.4	*	.5	2.9	*	-	.1	28.4	1.9
Barrie	.4	.9	.2	1.1	2.0	6.6	.5	.6	*	*	8.4	-	-	.1	20.8	1.4
Oakville	3.6	.5	1.9	.9	1.6	8.7	.5	1.2	*	.2	.4	*	-	.1	19.6	1.3
Cornwall	.1	.5	2.4	.3	.6	3.2	8.3	.5	*	.1	.3	*	-	.1	16.5	1.1
Guelph	.1	1.0	.2	1.2	2.7	8.9	.3	.4	*	.2	1.2	-	*	*	16.3	1.1
Ottawa	.5	.5	.2	1.1	1.2	8.3	1.1	.7	*	.5	1.5	*	-	.1	15.7	1.1
Simcoe	*	*	.1	.2	2.9	5.4	.9	*	-	.9	4.8	*	-	-	15.2	1.0
Kingston	*	.4	1.3	.4	2.4	5.7	.1	.4	*	*	3.7	*	-	*	14.4	1.0
Cochrane	-	.1	.1	.1	.4	.5	12.2	.3	-	-	*	-	-	*	13.7	0.9
Woodstock	.6	.6	.4	1.0	.4	6.8	.1	1.0	*	.1	1.0	*	-	*	12.0	0.8
Chatham	1.3	.3	.6	.6	1.0	5.6	.5	.6	-	.2	1.0	*	-	*	11.8	0.8
Kirkland Lake	*	*	*	.2	2.8	3.8	.5	.1	-	.3	2.0	*	-	*	9.7	0.7
Brantford	.4	.6	.2	1.1	.6	3.8	1.3	1.3	*	*	.2	*	-	*	9.5	0.6
Brockville	.1	.2	1.2	.7	.5	4.3	.3	.3	-	*	.7	-	-	*	8.3	0.6
Belleville	.3	.3	.1	.5	.2	4.2	.2	.4	*	.1	.3	*	-	.1	6.9	0.5

* Quantities Less Than 100
* PCB's Not Included in Municipal Totals
Note: Totals may not add due to rounding

TABLE S-4

ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA (Cont'd)

(TONNES x 1000)

Municipality \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oils & Greases	Oil/Water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals and Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges & Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	TOTAL %
St. Thomas	1.4	.6	.3	.7	.3	2.4	•	.5	•	-	.1	•	-	•	6.2	0.4
Cobourg	.6	.4	.1	.3	.6	2.2	.6	.3	•	•	.6	-	-	•	5.5	0.4
Halton Hills	.4	.3	.1	.9	.4	2.6	•	.2	•	•	.1	•	-	.1	5.0	0.3
Stratford	.3	.2	.2	.7	.3	1.8	•	.6	•	•	.7	-	-	•	4.9	0.3
North Bay	•	.3	.1	.3	.6	2.6	•	.2	•	•	•	-	-	.3	4.5	0.3
Peterborough	•	.4	•	.6	.2	2.4	.1	.3	•	.1	.1	•	-	•	4.3	0.3
Sudbury	•	.1	.1	.3	.4	1.6	.3	.1	-	.1	.6	•	-	•	3.6	0.2
Grimsby	•	.2	•	.3	.1	2.1	.6	.1	•	•	•	•	-	•	3.3	0.2
Hawkesbury	•	•	•	.2	.4	1.8	.1	•	-	.1	.5	-	-	•	2.4	0.2
Huntsville	•	.2	•	.1	.1	.3	.6	.3	-	•	.6	-	-	•	2.0	0.1
Lindsay	.1	.3	•	.1	.6	.3	•	.1	•	•	.6	•	-	•	2.0	0.1
Owen Sound	.2	•	.1	.2	.1	1.3	•	.1	-	-	•	-	-	•	2.0	0.1
Wanaville	•	•	•	.1	.1	.8	.2	•	-	.2	.1	•	-	•	1.6	0.1
Orangeville	•	.1	•	.2	.1	.8	•	.3	•	•	•	-	-	•	1.6	0.1
Welherton	•	•	•	.1	•	.6	•	•	-	•	•	-	-	-	.9	0.1
Other-Northwest	•	.1	•	.1	.8	.5	9.5	.7	-	-	•	-	-	•	11.7	0.8
Other-Southeast	.2	.3	.2	.3	1.6	1.4	.2	.5	-	.2	6.2	•	-	•	11.3	0.8
Other-South Central	.1	.5	•	.5	.9	1.0	•	.2	-	•	.1	-	-	•	3.4	0.2
Other-Southwest	•	.1	•	.3	.3	1.0	•	.2	•	•	•	•	-	•	2.1	0.1
Other-Northeast & Central	.1	.2	•	.2	.1	.2	.4	.4	-	-	•	-	-	-	1.7	0.1
Total	47.1	42.1	51.0	69.0	221.4	574.3	144.7	50.0	0.7	34.8	246.8	0.6	0.2*	7.6	1490.3	100.0

• Quantities less than 100

* PCB's Not Included in Municipal Totals

NOTE. Totals may not add due to rounding

1.0 INTRODUCTION

1.1 Objectives

This report has been prepared to present the methodology and findings of the Waste Quantities Study, a study of hazardous liquid industrial waste and hazardous waste generation in the Province of Ontario. The data generated in this study will provide fundamental data for future decisions by Ontario Waste Management Corporation (OWMC) in formulating plans to fulfill its mandate to provide facilities for recovery and/or treatment and the safe disposal of hazardous liquid industrial waste and hazardous waste.

The main objectives of this study are:

- to determine the types, quantities and sources of hazardous liquid industrial waste and hazardous waste generated in Ontario

- to identify facilities now recovering, treating and disposing of hazardous liquid industrial waste and hazardous waste generated in Ontario

- to develop a computerized data base that can be updated and used as a monitoring tool.

The data generated by this study will be used by OWMC to assist in: identifying potential locations for recovery, treatment and disposal facilities; designing treatment facilities; and determining the types and quantities of waste that will be received by OWMC facilities.

In this report, the term "waste" refers to hazardous liquid industrial waste and hazardous waste.

1.2 Study Overview

This study was conducted in four phases:

- initial data assembly
- data analysis
- survey of waste generators
- report preparation

Key activities undertaken in the study are outlined in the following paragraphs.

The first activity was to develop a study methodology. Approaches used in other North American studies were evaluated and it was decided to employ a "generator factor - ground-truthing" approach that involved:

- the analysis of data from surveys conducted in other jurisdictions to estimate waste generated on a per production employee or per plant basis;

- the development of a computer model using these "generation factors" and Ontario estimates of manufacturing employees and plants;

- conducting a survey of manufacturing establishments to "ground-truth" the generation factors and to make adjustments to the model where necessary; and

- prediciting the quantity, type and source of waste generated in Ontario.

Concurrent with the methodology selection, a review was undertaken of North American waste categorization systems. These systems were evaluated to identify the most comprehensive and useful means to classify liquid industrial and hazardous wastes.

During these and succeeding activities, available data were collected for quantitative analysis and testing for reliability and accuracy. Information was collected and analysed on industrial employment and production, industrial growth projections and productivity differentials between Ontario and other jurisdictions for which "generation factors" were available. Existing facilities in Ontario for waste treatment, recovery, reduction, exchange and disposal were also inventoried.

A series of "technical" interviews with industrial spokesmen, trade associations, government waste experts and industrial process specialists were conducted. These interviews focussed on industrial growth potential in Ontario, waste management problems in specific industries and potential technological changes that might affect future waste generation.

Using these background data, a first run of the waste generation computer model was undertaken. The results were compared to other estimates of waste generated in Ontario. This activity served to identify anomalies in the data base and the model. Industrial groups for which "ground-truthing" was required were identified from this first run. An update mechanism was also established in the computer data files to allow updating or revision to the data base when further information becomes available.

The next phase of the study was the survey of industrial waste generators, the ground-truthing of the waste generation model. Interviews with plant managers and key personnel were conducted in approximately 100 industrial establishments, identified on the basis of significant waste generation, representative establishment size and reliability of existing data. The information obtained from these interviews was then compared with the first generation estimates and appropriate changes made to the generation factors.

The estimates reported herein are total waste generated by industry in Ontario. It must be noted and indeed emphasized that a significant quantity of this waste is currently:

- treated or disposed of at existing waste treatment facilities
- recycled, reused or reclaimed, either in the generating plant or by others
- treated or disposed of at on-site facilities
- sewered
- stored
- exported for treatment or disposal.

The waste estimates predicted by the model do not, therefore, represent those hazardous liquid industrial waste and hazardous waste quantities requiring treatment or disposal.

It must also be noted that the model and the data files are compatible to future update. The model results can be refined as additional information becomes available from future OWMC activities and other sources.

1.3 Report Format

This report has been written and prepared in a style to ensure that all readers can understand the assumptions, methodology, results, and conclusions. Given the sometimes confusing jargon and nomenclature associated with liquid industrial and hazardous waste, a glossary of terms is provided as Appendix A. A bibliography has also been included, as Appendix B.

2.0 STUDY BASIS

2.1 General

This section of the report details the methodology used to estimate the generation of hazardous liquid industrial waste and hazardous waste in the Province of Ontario. A brief discussion of alternative methodologies and the rationale for selection is given. The rationale behind the selection of a waste classification system is also discussed in this section.

2.2 Alternative Methodologies

A detailed review of relevant waste quantity studies was carried out to select a methodology appropriate to this study. This review revealed four basic approaches to waste estimation:

- permit or manifest system records
- reported disposal data
- industrial surveys through visits or questionnaires
- generation factor estimates using the known industrial base.

The manifest system, as used in the United States under the Resource Conservation and Recovery Act (RCRA), involves reporting of waste quanitities transported over public roads. The Ontario Ministry of the Environment maintains a similar permit system (the "Waybill"). There are several shortcomings to basing estimates on this type of data base: not all waste generated is transported over public roads, thereby requiring a permit; some wastes may be transported over public roads illegally (i.e. without permits); wastes may be improperly characterized on the permit; and waste internally reused or recycled is exempted from manifest systems.

The disposal data approach has been used in New York State, where all waste disposal facilities must report types and quantities of hazardous wastes received. The shortcomings involved in using this approach include the fact that not all waste is disposed of at licensed facilities and disposal reports may improperly characterize wastes. In any event, such data do not exist for Ontario.

The industrial survey technique, as used in the State of Illinois, requires the interviewing of a statistically accurate sample of potential waste generators. In Ontario, with approximately 28,000 industrial and commercial establishments and an unusually broad range of industry types, this approach requires a long term, expensive survey to achieve accuracy.

The fourth approach employs the generation factor methodology. This has been used extensively in the United States as well as in studies of hazardous waste generation in Northern and Western Canada and in the Maritime provinces.

This methodology involves a computer program that will accept, as input, estimates developed in other studies of waste generated on a per employee or per plant basis; these generation factors are then applied to Ontario employment or plant statistics. This methodology suffers from short-comings in that it does not take account of differences in technology or productivity from one jurisdiction to another.

2.3 Selected Methodology

The methodology selected for this study is a combination of the generator factor and survey approaches: generation factors are derived and then the key generators identified in the model are interviewed to ground-truth the factors and alter them where required. The methodology is summarized as follows:

- previous studies in other jurisdictions plus any available local data are translated to a waste per employee basis specific to each type

of waste for each type of industry; at present, there are up to 12 estimates of waste generated per employee for any given waste type-industry type combination

- waste and geographic classification systems are selected

- data on local employment by industry type is obtained

- a computer program is developed that takes the above data and uses a mathematical equation that discounts extreme estimates and obtains the mean of the remaining estimates for any specific waste type - industry type combination; the program then multiplies this mean estimate of waste generated per employee by the number of employees within that industry

- a Technical Interview Program is undertaken to determine recent and future industrial technological changes and assist in growth projections

- a survey of sample companies within the key industries identified is conducted. This survey seeks to verify waste generation rates and/or provide new waste generation rates

- waste generation rates are adjusted according to the results of the survey

- the program is run again to provide an estimate of hazardous liquid industrial waste and hazardous waste generation in Ontario by waste type and source.

This methodology improves the standard generation factor method by including direct surveys of key generators in order to verify factor estimates. It also overcomes the time and cost constraints inherent in a large scale interview program.

The objectives of this study are effectively met using this methodology. By estimating waste generation on an industry-specific basis, future trends in waste generation can be predicted using industrial growth forecasts. The effects of potential process changes on waste quantity and type generated can be studied. By estimating wastes on a plant by plant basis, the geographical sources of waste are identified. Finally, because the model uses specific industry and waste types, it is possible to monitor waste generation by reviewing current employment or production data.

The use of a computer model does not, of course, obviate the need for applying professional judgement to data evaluation and the analysis of results. At each stage, the adequacy of the data, the program and the model results have been subjected to detailed analysis and the "reasonableness" of the results has been discussed within the study team and with industry experts.

2.4 Applicable Wastes

Legislation establishing OWMC refers to its mandate for treating "liquid industrial waste and hazardous waste". A key question is, therefore: what wastes are included in this description, i.e. what are the "applicable" wastes?

The Ontario Ministry of the Environment (MOE) is currently preparing hazardous waste definitions and regulations. These regulations were not available for consideration in this study.

Bill 90 ("An Act to Establish the Ontario Waste Management Corporation") suggests that OWMC is responsible for "wastes including sewage" (Sec.3(b)).

Ontario Order-In-Council #OC 1076/81 (July 8, 1981) is more specific charging OWMC with the responsibility of establishing and providing waste disposal facilities "for the treatment and disposal of liquid industrial waste and hazardous waste".

In Ontario liquid industrial waste and hazardous waste have been defined as follows:

"hauled liquid industrial waste" means liquid waste, other than hauled sewage, that results from industrial processes or manufacturing or commercial operations and that is transported in a tank or other container for treatment or disposal, and includes sewage residue from sewage works that are subject to the provisions of The Ontario Water Resources Commission Act (R.R.O. 1980, Reg. 309)

"hazardous waste" means waste that requires special precautions in its storage, collection, transportation, treatment or disposal, to prevent damage to persons or property and includes explosive, flammable, volatile, radioactive, toxic and pathological waste (R.R.O. 1980, Reg. 309).

Applicable wastes have therefore been identified by a process of exclusion:

- from total waste generated, non-industrial wastes (e.g. municipal solid waste, domestic sewage) were excluded to arrive at total industrial waste

- from total industrial waste, those wastes not requiring treatment and disposal because they are either non-hazardous or because they remain on-site (e.g. dredgings, mining overburden, drilling muds, agricultural wastes, forestry residues) were excluded to arrive at industrial wastes requiring treatment and disposal

- from industrial wastes requiring treatment and disposal, radioactive wastes were excluded (because they are a federal responsibility) to arrive at non-radioactive industrial wastes requiring treatment and disposal.

At this point, it became apparent that many of the remaining wastes could be safely and satisfactorily handled by conventional facilities such as sewage treatment plants, municipal waste incinerators and municipal landfills. These wastes were therefore excluded to arrive at the

definition of applicable wastes as being: those industrial, non-radioactive wastes requiring treatment and disposal by special facilities (i.e. by facilities other than sewage treatment plants, municipal waste incinerators and municipal landfills).

2.5 Waste Classification

An important task in the study was to select or develop a system to classify wastes. Four criteria were developed for selecting a classification system:

- the classifications should be compatible with waste treatment technology
- the classifications should be compatible with other North American inventories to allow utilization of the generation factor approach
- the system should allow for a significant degree of disaggregation, i.e. wastes from a plant should not all be reported as a single quantity
- the system should have as few "miscellaneous" categories as possible.

Seven classification systems were reviewed: four systems were quickly discarded as not meeting the above criteria (States of Illinois, Minnesota and New York and the Northern and Western Canada study); three systems were subjected to more detailed review - Ministry of the Environment (MOE) Classification Guideline for Hauled Liquid Industrial Waste, the United States Resource Conservation and Recovery Act (RCRA) and the University of California at Davis (UCD) system as used in the State of California. Further study led to the exclusion of the RCRA system because of its inability to describe most Ontario wastes adequately.

The MOE and UCD systems are compared in Table 2-1. The MOE classifications fail to meet several technical requirements, most notably waste phase, heat content, pathogenicity and presence of reactive anions

TABLE 2-1

COMPATABILITY OF WASTE CLASSIFICATION SYSTEMS
WITH TECHNICAL PROJECT REQUIREMENTS

	UCD	MOE
Waste Qualities		
Waste phase	*	X
Particle size (especially large solids)	P	X
Pumpability (i.e. tars versus sludges)	X	X
Heat content	P	X
High corrosivity	P	P
Toxic chemicals (e.g. biocides)	P	P
High reactivity	P	X
Strong oxidizers	X	X
Pathogenicity	X	X
High vapour pressure organics	P	P
Specific Wastes		
PCB's	*	*
Borates	X	X
Cyanides	P	*
Sulfides	P	X
Heavy metal sludges	*	P
Explosives	X	X
Pesticides	*	*
Halogenated hydrocarbons	*	X
Discarded commercial chemicals	X	X

Legend

* good fit
P partial fit
X poor fit

and heavy metals. The UCD categories provide for waste phase, heat content and presence of heavy metals although they also omit pathogenicity, and some specific waste types. These shortcomings were identified and additional classifications included. The basic UCD system employs 96 waste stream categories (as opposed to the 23 used in the MOE system) and is considerably more specific than the MOE system. The four miscellaneous categories in the UCD system accounted for only 0.5% of wastes recorded in the State of California study while the MOE miscellaneous classes accounted for 15% of all wastes recorded on the MOE waybill system in 1980/81.

The UCD system also allows physical and chemical properties of a waste stream to be identified and compared. This was an important consideration in the selection of the UCD classification system for this study.

Based on the above reasons, the UCD system was selected for use in this study. UCD categories not applicable to OWMC's mandate were not estimated. Appendix C to this report provides a description of the UCD waste categories and notes those categories deemed to be outside of OWMC's mandate (and hence, not calculated).

2.6 Industry Classifications

As noted in the discussion on study methodology, estimates of per employee waste generation are specific to both type of waste and type of industry. Industries may be categorized according to the Standard Industrial Classification (SIC) system of either Canada or the United States. The U.S. SIC was selected for use in this study for three reasons:

- all previous North American waste estimation studies have used the U.S. system; therefore available generation factors are based upon that system

- the U.S. system is more detailed than the Canadian system. For example, its manufacturing section contains approximately 450 4-digit industry categories, allowing a significant degree of disaggregation

- the best available data base on industrial employment and location in Ontario is categorized using the U.S. SIC.

Appendix D presents a list of the U.S. Standard Industrial Classification categories.

2.7 The Waste Generation Model

This section of the report has described the methodology used to estimate waste quantities generated in Ontario and the basis for data input. The resulting waste generation model may be thought of as a matrix. As Figure 2-1 illustrates, each box contains a generation factor specific to one SIC industry and one UCD category of waste. With more than 450 SIC industries, the matrix contains over 40,000 potential boxes or SIC-UCD combinations (although, not all industries produce all types of waste and thus not all boxes are utilized). This level of disaggregation enables fine-tuning of the model and sensitivity testing of assumptions and hypotheses.

UCD WASTE CLASSIFICATION / STANDARD INDUSTRIAL CLASSIFICATION	UCD 111 ACIDIC SOLUTIONS WITH HEAVY METALS	UCD 215 SPENT SOLVENTS WITH OTHER METALS OR NON-METALS	UCD 282 OILY TANK BOTTOMS
SIC 3312 BLAST FURNACES AND ROLLING MILLS	WASTE GENERATION RATE X PRODUCTION EMPLOYEES	WASTE GENERATION RATE X PRODUCTION EMPLOYEES	THIS WASTE IS NOT GENERATED BY SIC 3312
SIC 2851 PAINTS, VARNISHES, ETC.	THIS WASTE IS NOT GENERATED BY SIC 2851	WASTE GENERATION RATE X PRODUCTION EMPLOYEES	WASTE GENERATION RATE X PRODUCTION EMPLOYEES
SIC 2911 PETROLEUM REFINING	WASTE GENERATION RATE X PRODUCTION EMPLOYEES	WASTE GENERATION RATE X PRODUCTION EMPLOYEES	WASTE GENERATION RATE X PRODUCTION EMPLOYEES

WASTE GENERATION MODEL
MATRIX EXAMPLE
FIGURE 2-1

3.0 DATA COLLECTION

3.1 General

Once the basis for estimating waste generation was established (in terms of methodology and waste stream categorization), the next step was to collect, assemble and analyze information that would be fed into the computer model. Data collected included:

- estimates of industrial employment and production in Ontario
- productivity differentials between Ontario and other jurisdictions
- specific industry waste problems
- existing treatment and disposal practices.

3.2 Waste Generation Factor Sources

An extensive literature search was undertaken to identify and evaluate waste generation studies that would be useful in preparing generation factors. Considerations included:

- the similarity of the industrial base to Ontario
- the degree of waste estimate disaggregation by type
- the methodology used in making waste estimates
- the date of the study

From this evaluation, the following data bases were selected:

- Mitre Corporation (for the U.S. Environmental Protection Agency)

- State of New York
- State of Illinois
- State of Minnesota
- Northern and Western Canada.

3.3 Employment by Industry

Various sources of industrial employment data were reviewed to provide input to the generation model, including Ontario Ministry of Industry and Tourism, Statistics Canada, Dun & Bradstreet and Scott's Directory.

The Ministry of Industry and Tourism (MIT) maintains a company information system geared to promoting exports. This system lists approximately 12,000 manufacturing establishments; information on production is available for about 3,500 of these companies. The information on the system is classified by the Canadian International Trade Classification system rather than the SIC system. The MIT data were made available to the study team and used as a cross-reference to other data sources.

Statistics Canada provides employment information on the basis of the Canadian SIC system. While not sufficiently disaggregated for use in the model, the data did prove useful in the analysis of productivity differentials and in attempting to establish the ratio of production employees to total employees for each industry (the generation factors are applied to production employees only).

Dun & Bradstreet Canada Ltd. was found to have available a computer listing of all industrial and commercial establishments in Ontario by U.S. SIC, employment and location. Approximately 28,000 individual establishments were identified on the tape leased from Dun & Bradstreet. This information included the noting of secondary SIC's for companies where appropriate (secondary SIC's denote other types of production activity within the same establishment). Dun & Bradstreet was the main source of industrial employment data used in the report.

A fourth source of data was Scott's Industrial Directory of Ontario Manufacturers. Scott's listings are also by U.S. SIC and include employment data, however the listings are not as extensive as Dun & Bradstreet and a computer tape was not available. Scott's Directory was used as a cross-reference and check on the Dun & Bradstreet data.

As a final check on the data assembled, all establishments listed with more than 100 employees on the Dun & Bradstreet tape were cross-checked with other listings or by telephone to ensure reasonable correctness of data as to SIC listing and employment figures.

3.4 Productivity Differentials

The use of generation factors derived from U.S. studies is complicated by differences in industrial productivity between Canada and the United States. Productivity is the measure of the efficiency in combining all resource inputs (labour, capital, energy, etc.) to product the finished product (output). Differences in labour efficiency and production technology, for example, can have a significant effect on output generated per production employee. Although the generation model is based on waste generated per employee, waste is actually generated on a per unit output basis. However, it is extremely difficult, if not impossible, to obtain accurate estimates of output on a manufacturing establishment basis and waste generated per employee is used as a substitute measure. Nevertheless, if Industry X in Canada produces more units of output per employee than does Industry X in the U.S. (i.e. if it is more productive), more waste will be generated per employee in Canada (other factors being equal).

It was necessary therefore to estimate Canada - U.S. productivity differentials and to factor these differentials into the generation model. A review of productivity data was undertaken and detailed Canada - U.S. comparisons were found for 1972 and 1974. Discussions with Canadian productivity experts at the Federal Department of Finance and the Conference Board of Canada indicated that, in 1981, Canadian industry

was estimated to be 85-95% as productive as American industry. Because of the difficulty in applying 1972 and 1974 data to specific SIC's in 1981, an average Canada: U.S. productivity ratio of 0.9:1 was assumed. Where data indicated that Canada was more productive (SIC 24 - Lumber and Wood Products and SIC 33 - Primary Metal Industries) a ratio of 1.1:1 was assumed. In one case (SIC 37 - Transportation Equipment), equal productivity was assumed. In four cases where data indicated significantly lower Canadian productivity (SIC 26 - Paper Products, SIC 28 - Chemicals, SIC 35 - Machinery, Except Electrical and SIC 36 - Electrical and Electronic Machinery), a ratio of 0.75:1 was assumed.

A discussion paper on Canada - U.S. productivity differentials is presented as Appendix E to this report.

3.5 Production Employee Ratios

The waste generation model multiplies generation factors by estimates of production employees. The employment data base, however, provided estimates of total employment at each industrial establishment. Ratios of production employees to total employees for each SIC were derived directly from data published by Statistics Canada ("Manufacturing Industries of Canada: National and Provincial Areas, 1978", December, 1980).

3.6 Technical Interview Program

As part of the data collection phase of this study, 30 interviews were held with industry spokesmen, government officials and industrial process specialists. In each interview, five basic questions were posed:

- Do you have any information concerning liquid industrial waste and hazardous waste generation in your industry related to: number of employees; sales; number of plants; SIC- or waste-specific generation factors?

- Are any other estimates available for waste generation other than those identified above, such as industry totals?

- Are there any studies underway related to the above two questions?

- Do you have any information on industrial growth over the next 10 to 20 years by: number of employees; sales; number of plants?

- Do you have any information that would assist in predicting waste generation in the future (e.g. new raw materials or processes)?

Representatives of the following organizations were interviewed:

- American Electroplaters' Society
- Canadian Agricultural Chemicals Association
- The Canadian Chemical Producers' Association
- Canadian Fertilizer Institute
- The Canadian Institute of Mining & Metallurgy - referred to Ontario Mining Association
- The Canadian Manufacturers' Association
- Canadian Manufacturers of Chemical Specialties Association
- Canadian Paint and Coatings Association
- Canadian Printing Ink Manufacturers Association
- Canadian Pulp and Paper Association
- Canadian Steel Environmental Association
- Canadian Textiles Institute
- Chemical & Petroleum Waste Disposal Limited
- City of Toronto Health Advocacy Unit
- Dry Cleaners & Launderers Institute (Ontario)
- The Mining Association of Canada - referred to Ontario Mining Association
- Motor Vehicles Manufacturers' Association

- Multiplex Chemicals Limited
- Ontario Chamber of Commerce
- Ontario Hydro
- Ontario Mining Association
- Ontario Ministry of the Environment
- Ontario Ministry of Health
- Petroleum Association for the Conservation of the Canadian Environment
- Pharmaceutical Manufacturers Association of Canada
- Rubber Association of Canada
- Shell Canada
- Steico Inc.
- Suncor Limited
- Tanners Association of Canada

The interviews yielded significant waste generation information in several cases. An overall feeling for the concerns of various industrial groups was obtained as regards industry waste management problems.

3.7 Existing Treatment and Disposal Practices

Wastes generated by industry in Ontario are treated and disposed of by a number of methods. These include:

- on-site facilities including incineration, landfill, land farms, physical/chemical treatment, private waste water treatment facilities and recycling

- off-site treatment and disposal facilities including incineration, recycling, reclamation, reuse, landfill and municipal sewage treatment plants

- re-refining of waste oils
- waste export to the United States or other provinces for a variety of treatment and disposal methods
- on- or off-site waste storage
- waste exchange

Significant quantities of waste are treated, disposed or recycled at on-site industrial facilities. The primary method of treatment appears to be private waste water treatment plants. The discharge of treated effluent from such plants is either point-source (i.e. to a surface water receiver) or to a sewer. The Ministry of the Environment is responsible for point-source discharges and local and/or regional governments regulate sewer discharges by sewer use by-laws. Residuals from the on-site treatment of waste water require further treatment and are usually hauled to off-site treatment facilities.

On-site physical/chemical treatment practices are primarily neutralization and separation. Acidic or basic wastes are typically generated in large volumes by industry. Rather than hauling these quantities off-site for treatment, the wastes are neutralized and discharged to a sewer. Similarly, large volume aqueous wastes with a solids content are dewatered on-site by industry. The effluent is discharged to a sewer while the solid waste usually requires further treatment.

Industries such as cement manufacturing may burn waste solvents and oils in kilns as supplementary fuel. These wastes are usually not generated on-site but "reused" from those industries generating solvent or oil wastes. In Ontario this practice is considered to be waste reuse and is not required to be Waybilled. A large number of hospitals in Ontario have on-site incinerators for the disposal of pathological wastes. Those hospitals without on-site incineration utilize frozen storage and transport to other facilities with incineration capability.

Increasing amounts of waste solvents and oils are being reprocessed for reuse or recycle primarily at off-site facilities. This is done on either a "toll basis", where waste from a particular industry is collected, re-processed and returned for a fee, or where a reprocessor purchases the waste from a generator for sale elsewhere.

Landfills and biological land farms continue to be a primary method of waste disposal. Land farms are utilized by those industries generating biological wastes (primarily waste oils.)

Oil re-refining is known to be practised at three facilities in Ontario. Recovery of refined oil varies from 70 to 90 percent depending on the process used.

Significant quantities of polychlorinated biphenyl (PCB) wastes are currently being stored in Ontario. In Ontario there are two licensed storage facilities: Ontario Hydro has a storage area soley for Ontario Hydro waste and there is a private operation in Smithville that stores drummed PCB's. PCB's are also stored on-site in drums, bulk tanks or contaminated equipment carcasses.

The Canadian Waste Materials Exchange operates a waste exchange for industry in Canada. The Exchange acts as an information broker via a bulletin listing waste streams available for exchange. This bulletin is published six times a year and is sent to several thousand companies. It is estimated that less than 1 percent of waste generated in Ontario is exchanged by this method.

There is at least one private waste exchange operating in Ontario; the type and quantity of waste exchanged is not available.

The Ministry of the Environment Waybill system was examined to identify off-site facilities and wastes exported for treatment or disposal. Discussions were also held with Ministry of the Environment officials to discuss typical on-site and off-site recovery, treatment and disposal practices not subject to the Waybill.

Table 3-1 identifies the quantity of liquid industrial waste Waybilled from April 1, 1981 to March 31, 1982. Further information on quantities is found in Appendix F.

Approximately 54 percent of the liquid industrial waste recorded on Waybills during 1981/82 was received at landfill sites, land farms, sewage plants, or used for oiling roads or treated outside the Province, primarily in New York State or Michigan.

Tricil Limited, located in Corunna, outside Sarnia, received almost 30% of all Waybilled waste at their incineration and landfill facilities. Tricil also has transfer facilities in Mississauga and Windsor for haulage of liquid industrial waste.

An evaluation of the waste received by type at existing facilities indicates that:

- large quantities of solvents (chlorinated and organic), waste oils, and oil and water are presently being reclaimed, recovered or reused

- both organic and inorganic wastes are receiving some form of treatment (primarily by Tricil)

- wastes such as PCB's and other chlorinated wastes are not treated in Ontario. In the case of PCB's, minimal amounts are transported out of Province. Other chlorinated wastes are being received at United States facilities.

About 20 transfer station operations are licensed for receiving waste in Ontario. These facilities are primarily "bulking" operations, although larger facilities have tankage facilities for blending and/or bulking.

The concentration of existing waste facilities generally corresponds to the sources of waste generation identified in this study (i.e. the Sarnia/ Windsor and Toronto/Hamilton/Niagara areas).

TABLE 3-1
SUMMARY OF WAYBILL ACTIVITY
APRIL 1, 1981 TO MARCH 31, 1982

Receiver	Quantity (tonnes)
Incineration	70,000
Sewage Plants	14,000
Reclaimed/Reused	38,000
Landfills	51,000
Private Landfills and Land Farms	29,000
Exported Out-of-Province	26,000
TOTAL	228,000

4.0 GENERATOR INTERVIEWS

4.1 General

Having designed the waste generation model and inputted data from available sources, the next step in the process was to calibrate the model to the "real world". The major activity in this calibration exercise was to survey key generators of waste in Ontario and to adjust the generation factors where required. Other calibration activities included the analysis of individual model predictions to assess their consistency and to compare calculated estimates with other waste quantity inventories.

4.2 Criteria for Generator Selection

The primary objective of the generator interviews was to verify the waste characteristics and generation factors in the model to ensure applicability to Ontario industry. It was also important to evaluate process technologies and, through discussions with industry engineers, determine if waste types and quantities are likely to change; to identify internal waste treatment facilities; and to determine production and employment trends.

The selection of firms to be interviewed was undertaken in two stages. The first stage required evaluation of waste estimates by type and source by SIC on the basis of the following criteria:

- industries that generate more than 1% of total wastes
- industries for which the model had multiple or questionable generation factors or no generation factors
- a range of industries so that all UCD categories were covered.

From the first cut estimate of waste quantities generated by the model, SIC's which met one or more of these criteria were the following:

SIC	INDUSTRY
2621	Paper Mills
2751/52	Commercial Printing
2813	Industrial Gases
2819	Industrial Inorganic Chemicals
2833	Medicinal Chemicals and Botanical Products
2834	Pharmaceutical Preparations
2841/42	Soaps, Detergents and Cleaners
2851	Paints, Varnishes
2869	Industrial Organic Chemicals
2879	Pesticides and Agricultural Chemicals
2911	Petroleum Refining
3079	Miscellaneous Plastics Products
3312	Blast Furnaces and Rolling Mills
3471	Electroplating
3496	Fabricated Wire Products
3599	Machinery except Electrical
3679	Electronic Components
3714	Motor Vehicle Parts and Accessories

The second stage involved the selection of firms for interview within those SIC groups. Approximately 100 firms were selected according to the following criteria:

- firms with a large number of employees (assuming those firms with large employment generate the most waste within an SIC)
- firms with diverse product lines (i.e. secondary SIC's)
- geographical distribution (i.e. selection of firms located throughout Ontario)
- employment range (i.e. selection of firms representing small, medium and large employment)

4.3 Interview Format

Officials of the selected companies were interviewed by two-person teams specially trained for this assignment. The interviewers were responsible for assigning UCD waste classifications, to ensure uniformity in the collected data. Rather than using a detailed questionnaire, interview teams were given an interview guide outlining areas of interest for which information was sought.

The interview guide covered the following areas:

- Company Profile
  - nature of production activity
  - typical products and proportion of production
  - number of production employees
  - recent plant shut-downs
  - typical production year
  - sanitary sewer connections.
- Wastes
  - quantity and type of waste generated
  - company's definition of "hazardous"
  - waste quantity estimation techniques
  - waste variability by season
  - potential future waste generation increases or decreases.
- Disposal Practices
  - transported off-site
  - disposed of on-site
  - storage
  - waste exchange
  - problem wastes.

- Recyclying, Etc.

  - present and potential recycling, reuse, reclamation and recovery.

4.4 Survey Results

Waste generation and waste management practices are sensitive matters to many companies. To a large extent, this stems from the fact that waste types and quantities provide significant clues to production technologies and practices, information that is highly confidential for competitive reasons. In order to obtain the highest quality of information from waste generators, therefore, complete confidentiality was promised to the companies interviewed. Therefore neither names of the companies interviewed nor the results of any interviews are reported. Data obtained from the survey were added directly into the waste generation model in the form of generation factors.

Excellent cooperation was received from the companies interviewed and the information obtained was of high quality. OWMC expresses its appreciation to those companies that took part in this program.

5.0 CATEGORIZATION OF WASTES

5.1 General

As noted in the introduction, this study attempts to estimate the quantity generated of hazardous liquid industrial wastes and hazardous wastes that cannot be safely and properly treated and disposed of via sewage treatment plants, municipal waste incinerators, or municipal landfills.

5.2 Physical Characteristics

Liquid industrial wastes and hazardous wastes may be physically described as liquid, sludge or solid.

A liquid waste may be generated wherein the waste stream contains residuals with hazardous characteristics; such liquid wastes may not be economical or desirable to pretreat or separate. Treatment facilities will likely receive the bulk of this waste that is not recycled, reclaimed or reused.

A liquid waste may also be generated in the form of an effluent containing suspended or dissolved materials. The liquid waste may then be treated or concentrated so that a sludge fraction is produced and the resulting effluent does not have hazardous characteristics. Such a liquid waste may receive pretreatment in order to reduce the volume or tonnage of waste transported to a treatment facility. Once this liquid waste stream has had the suspended or dissolved materials removed, the liquid phase generally requires little or no treatment prior to sewer discharge.

A sludge may be broadly defined as a viscous fluid containing appreciable levels of suspended matter. A solid may be defined as a substance that retains it shape in absence of containment. Generally, neither solid nor sludge wastes generated directly from production processes can be further treated to reduce quantities.

5.3 Waste Categories

All wastes estimated in this study have been classified by the UCD system. To more easily understand the nature of these wastes and to assist in addressing the question of how these wastes can best be treated or disposed, the waste types have been grouped into 14 categories based on similarity of physical and chemical characteristics and similarity in terms of general treatment requirements.

These 14 categories are presented in Table 5-1. For each category, the generic technologies that may have applicability for future treatment are identified. The six generic technologies are:

- resource recovery techniques such as distillation, blending, ion exchange, etc.
- physical/chemical treatment
- thermal treatment or incineration
- biological treatment/disposal such as land farming
- solidification/fixation to secure landfill
- secure landfill.

Table 5-1 also presents the physical and chemical characteristics of the waste categories and gives examples of the waste types.

TABLE 5-1

WASTE CLASSIFICATION AND CONSOLIDATION BY CHARACTERISTICS

DESCRIPTION OF WASTE STREAMS	PHYSICAL CHARACTERISTICS	CHEMICAL CHARACTERISTICS	UCD CODES	TREATMENT OPTIONS	RESOURCE RECOVERY	DISPOSAL OPTIONS
ORGANIC SLUDGES AND STILL BOTTOMS (NO OIL) Organic sludges containing metals Halogenated still bottoms Non-halogenated still bottoms	Viscous or Thixotropic when dewatered	Generally burnable except ash may contain metals. Heating value is net positive, but may require drying or special air pollution control for combustion	247, 248, 261, 252, 521, 263, 529, 446, 257	Incineration Landfarm		Fixation or Solidification Prior to secure landfill
SOLVENTS & ORGANIC SOLUTIONS Halogenated Non-Halogenated Mixed	Liquid with some solid contaminants	Reasonably flammable. High heating value. Halogenated vapors may be corrosive	211, 212 213, 214, 215, 216, 217, 221, 222, 223, 224	Incineration	Distillation Blending	
OILS AND GREASES Waste Lube Oil Other Oils and Grease	Dirty lube oils, cutting oils, hydraulic oils. Most contain solid contaminants.	High heating value. Generally neutral pH	281	Physical/ Chemical Incineration	Distillation	Land Farming
OIL/WATER MIXTURES Emulsified and Free Oil/Water Mixtures	Liquid with separate or dispersed phases. May become viscous at low temperatures	Generally neutral, low pH may result from emulsion breaking. Usually no positive heating value before separation	283	Physical/ Chemical Incineration	Blending or Distillation	Land Farming
ORGANIC AND OILY RESIDUALS Leaded Gasoline Unleaded Gasoline and Organics Food Waste Oil	Thick multi-phase material. Most have inorganics in with organics. May be thick or thixotropic	Partly combustible. pH may be variable. Could be volatile or odourous. May be explosive in confined containers	264, 282, 284, 285, 286, 288, 289, 447	Incineration	Lead may be recovered Reuse or distillation	Land Farming Secure Landfill or solidification prior to secure landfill
HEAVY METAL SOLUTIONS AND RESIDUALS Spent plating or etching Rinse and less concentrated aqueous solutions Sludges from plating and etching lines Sludges from treatment of solutions containing metals	Acid or alkaline liquids frequently with solids in solution Sometimes difficult to pump, physical dewatering required. Reclamation difficult because of stable precipitates	Extreme pH swings. complexation is prevalent, special pretreatment is usually needed. Stable chemical precipitates. Highly complexed ammonia, sulfide and/or cyanide species	111, 112, 113, 121, 122, 123, 131, 132 133, 141, 142, 143, 244, 251, 431, 433, 445, 523	Physical/ Chemical	Ion exchange	Fixation or encapsulation Secure Landfill or solidification

TABLE 5-1 (CONTINUED)

WASTE CLASSIFICATION AND CONSOLIDATION BY CHARACTERISTICS

DESCRIPTION OF WASTE STREAMS	PHYSICAL CHARACTERISTICS	CHEMICAL CHARACTERISTICS	UCD CODES	TREATMENT OPTIONS	RESOURCE RECOVERY	DISPOSAL OPTIONS
MISCELLANEOUS CHEMICALS AND PRODUCTS Organic Chemicals Inorganic Chemicals Salts	Properties variable. Some solids and liquids Containers found in all sizes including small laboratory sizes	Entire spectrum of products and properties	145, 152, 243, 245, 416, 513	Incineration	Possible but no general technology	Must be packed for disposal at secure landfill
PAINT AND ORGANIC RESIDUALS Latex paint and sludge Solvent based paint and sludge Wash and Rinse waters Adhesives and Glue	Thick sludge consists of aged paint and heels from drums. Highly viscous.	Mixtures may contain solvents. Also some chromium, zinc, lead found in pigments.	254, 258, 262, 454, 455	Incineration	Metal Recovery from ash possible	Ash may require fixation prior to secure landfill
AQUEOUS SOLUTIONS WITH ORGANICS (90 percent H_2O) Alcohols and Organic Acids Halogenated Solvents Non-Halogenated Solvents	May have volatile components. Sometimes particulate contaminants are present.	Largely neutral wastes with residual organics. May be azeotropic in nature.	225, 226, 227, 228	Biological	Steam stripping or distillation	To Sewer
ANION COMPLEXES Cyanide Sulfide Other Complexes	High TDS material which can be corrosive or erosive	Found in combination with metals or high salt solutions. pH is neutral to alkaline	146, 147 444	Physical/ Chemical Biological	Conversion (experimental)	Solidification landfill
SLUDGES AND INORGANIC RESIDUALS Ash Spent Catalyst	Most are solids with small amount of water. Most are not reactive. Some low rate leaching expected for arsenic, cadmium, acid, etc.	Chemically inert except for residual ion concentrations Leachates may be either acid or alkaline	151, 165, 167, 417, 441, 443, 518 509	Solidification or fixation prior to secure landfill		Sanitary Landfill
PESTICIDE AND HERBICIDE WASTES High Concentration Organics High Concentration with metals Cleanup water and dilute solutions	Liquids or Solids. Solids are likely to be present with Inorganic Carrier	Reactive compounds. Some halogens present. Some reactive non-metals	241, 532	Biological Incineration	Little Potential presently	

TABLE 5-1 (CONTINUED)

WASTE CLASSIFICATION AND CONSOLIDATION BY CHARACTERISTICS

DESCRIPTION OF WASTE STREAMS	PHYSICAL CHARACTERISTICS	CHEMICAL CHARACTERISTICS	UCD CODES	TREATMENT OPTIONS	RESOURCE RECOVERY	DISPOSAL OPTIONS
PCB WASTES High concentration Liquids (>500 ppm) Medium Concentration Liquids (<500 ppm) Contaminated Soil (<50 ppm)	High strength wastes are mostly liquids. Medium strength may be flushing liquids or soil or metals in contact with high strength	Unreactive except for high chloride content Volatility is low but lighter aroclor's are volatile	242	Liquid Incineration or salt conversion to inorganic salts		
CLEAN-UP RESIDUALS Solvent and Organic Waste Inorganic and metals Pesticides and Herbicides IIII	Cleanup materials are largely soil contaminated or wastes absorbed onto some solid matrix	Chemical composition depends upon nature of spill	512, 521, 528, 531		Possible in some cases through distillation or liquid/liquid extraction	Most are directly Buried in Sanitary Land Fill Secure Landfill

6.0 ESTIMATE OF WASTE QUANTITIES

6.1 Introduction

Wastes are generated by almost all manufacturing and other commercial activities as part of normal day-to-day activities. Previous sections of this report have described the study methodology, the Standard Industrial Classification system for classifying industry, the University of California at Davis system for classifying wastes and the 14 categories that group wastes by physical, chemical and treatment characteristics.

This section of the report presents estimates of waste generated in Ontario in 1981. These estimates form the output from the computer model and include the results of the interview survey of key generating industries.

Considering the broad statutory interpretation of OWMC's mandate, the total quantity of hazardous liquid industrial waste and hazardous waste requiring special treatment (i.e. not by sewage treatment plants, municipal waste incinerators or municipal landfills) has been estimated. This total includes waste now being discharged to sewers and waste treated, recovered or disposed of at on-site or off-site facilities.

6.2 Data Accuracy

The estimates produced from the waste generation model show the maximum amount of waste produced in Ontairo in 1981 (i.e. generated quantities).

The methodology used required that generation factors be determined for specific SIC-UCD waste streams. Where more than one generation factor existed for a particular SIC-UCD waste stream, an algorithm was used to eliminate factors that were far from the mean. These eliminated factors were construed to be in error, probably attributable to misunderstanding

or to agglomeration of too many different wastes within a single category. The remaining factors for the SIC-UCD waste stream were then averaged and the waste estimate is the result of multiplying this average factor by production employment in the industry.

Production processes may differ from company to company within any one SIC class. This may have an effect on the exact waste streams and the amount of waste generated per employee. Size of plant may also affect waste generated per employee. Only by actual measurement can the exact nature and quantity of the waste stream be determined. Given the magnitude of such a task, the model, supplemented by the interview survey, was utilized. It is believed that this approach yields a very good approximation of total waste generated in an industry, yet it is apparent that deducing from these results the exact nature and quantity of waste generated in any one plant is unlikely to be precise.

The model has been designed to incorporate productivity ratios so that non-Canadian generation factors are more applicable to Ontario industry. The results of interviews conducted as part of the study have been given due weighting within the model (i.e. they are treated as more than simply another generation factor). Corrections have been made to the employment-industry data base where errors were detected. Thus all attempts have been made to ensure that the estimates are as accurate (or error-free) as possible.

The remainder of this section of the report, plus Section 7 (Comparison with Other Surveys), shed further light on the accuracy of the estimates presented.

6.3 Waste Generated by Type

Total estimated wastes are 1,490,300 tonnes. Estimated waste generated by UCD waste type is presented in Table 6-1. Approximately 70% of the waste generated is of 9 types:

TABLE 6-1

ESTIMATED WASTE GENERATED BY UCD CATEGORY
(1981)

UCD WASTE	DESCRIPTION	TYPICAL WASTES	Estimated Waste Quantity (tonnes)
11 ACIDIC SOLUTIONS			
111	Acidic Solution with Heavy Metals	Pickle Liquor Rinse Water	149,300
112	Acidic Solution with Other Metals and Non-Metals	Demineralizer Regenerent	800
113	Other Acidic Solutions	Boiler Stack Scrubber Water with Dilute Carbonic Acid (H_2CO_3)	22,500
12 ALKALINE SOLUTIONS			
121	Alkaline Solution with Heavy Metals	Rinse Waters from Surface Cleaning of Metals	19,500
122	Alkaline Solution with Other Metals and Non-Metals	Demineralizer regenerent	700
123	Other Alkaline Solutions	Cleanup Water from Lime or Cement Kiln	55,200
13 METAL FINISHING SOLUTIONS			
131	Metal Finishing Solutions, Acid	Ammonia Based, Containing Copper, Tin, Lead or Cadmium	9,300
132	Metal Finishing Solutions, Alkaline	Contains Strong Complexing Agent and Copper, Tin, Lead and/or Cadmium	1,100
133	Spent Pickle Liquor	Strong Acids with Iron, Fluoride, Hydrochloric Acid (HCl), Sulfuric Acid (H_2SO_4), Nitric Acid (HNO_3)	213,400
14 OTHER AQUEOUS SOLUTIONS			
141	Aqueous Solutions with Heavy Metals	Cleaning Solutions from Tanks, Trucks, or Railroad Tankers	32,200
142	Aqueous Solutions with Other Metals	Rinse Water from Heat Treating Salt Baths, Contains Barium, Aluminum	200
143	Aqueous Solutions with Reactive Anions	Bleaching Solutions, Containing Sulfite, Chlorite, Fluoride, Bromide	2,300
145	Brine	Salt Solutions After Neutralization or Chlor/Alkali Production	6,400
146	Solutions Containing Cyanide	Plating Baths	4,300
147	Solutions Containing Sulfides	Plating Baths	2,500
15 INORGANIC SOLIDS			
151	Inorganic Solids	Foundry Sand with Phenolics	133,000
152	Inorganic Chemicals	Aged or Off Specification Chemicals Including Lime, Caustic Soda and Partial Containers of Laboratory Size	132,100

OCD WASTE	DESCRIPTION	TYPICAL WASTES	Estimated Waste Quantity (tonnes)
16 OTHER INORGANIC WASTES			
165	Spent Catalyst	Carbon or Metal Traces	2,000
167	Unidentified Inorganic Waste	Ash and Construction Residue	1,700
21 SPENT SOLVENTS			
211	Halogenated Solvents with Heavy Metals	Methylene Chloride, 1, 1, 1, Trichloroethylene Used for Metal Cleaning	3,700
212	Halogenated Solvents with Other Metals	Surface Cleaning and Degreasing Solvents	< 100
213	Other Halogenated Solvents	Freon with Other Solvents Used in Chemical Processing	2,000
214	Non-Halogenated Solvents with Heavy Metals	Toluene, Benzene, Xylene Contaminated with Catalysts	17,500
215	Non-Halogenated Solvents with Other Metals or Non-Metals	Acetone, Methylisobutylketone (MIBK) used in Paint and Varnish Formulation	300
216	Other Non-Halogenated Solvents	Methylethylketone and Other Solvents Contaminated with Dirt	4,700
217	Unspecified Solvents	Alcohols and Mixtures of Solvents	700
22 OTHER ORGANIC LIQUIDS			
221	Organic Liquids with Metals and Halogens	Dyes	< 100
222	Organic Liquids with Halogens Only	Chloroform, Carbon Tetrachloride	900
223	Organic Liquids with Heavy Metals Only	Nickel Carbonyl, Methyl Mercury	200
224	Other Organic Liquids	Creosote and Other Poly Aromatic Hydrocarbons	12,000
225	Aqueous Solutions with Non-Halogenated Residues Less Than 10%	Laboratory Mixtures	3,100
226	Aqueous Solutions with Halogenated Residues Less Than 10%	Waste or Rinse Waters After Degreasing	1,000
227	Aqueous Solutions with Non-Halogenated Organic Residues Greater Than 10%	Laboratory Mixtures	200
228	Aqueous Solutions with Halogenated Organic Residues Greater Than 10%	Wash or Rinse Waters After Degreasing	100
24-25 OTHER ORGANIC WASTES			
241	Pesticides and Wastes	Partial Containers, Tank Washings, Off Spec. Products, etc.	500
242	PCB Oils and High Strength (over 500 ppm) Liquids	From Transformers and Capacitors	200

UCD WASTE	DESCRIPTION	TYPICAL WASTES	Estimated Waste Quantity (tonnes)
243	Pharmaceutical Wastes	Off-Specification Drugs, Cleanup Waters, etc. Includes Items Such as Vitamins	1,700
244	Photochemical Wastes	Most Solutions Non-Toxic Except Those with Silver	5,000
245	Off-Spec. or Aged Organics	Can Include Solids and Liquids. Generally in Containers	200
247	Halogenated Still Bottoms	Spent Solvent or Waste Oil Recovery	2,500
248	Non-Halogenated Still Bottoms	Solvent Recovery Operations	7,500
251	Tannery Wastes - Liquid	Solutions with Hexavalent Chromium	1,900
252	Solid or Sludge Tannery Wastes	Leather Shavings with Chrome	1,000
254	Adhesives or Glue	Waste Glues, Mostly Aqueous, Some With Phenols	<100
257	Phenolics Wastes	Phenolic Oil, Toluene Diisocyanide Residue	1,300
258	Waste Tar and Residues		900
25	POLYMERIC MATERIAL WASTES		
261	Polymeric Resins	Polyester, Urethane, etc.	1,400
262	Latex Wastes	Cleanup Water, Paint, Latex and Acrylic Resins	9,600
263	Other Polymeric Wastes	Kettle Bottoms, Thermoplastic Resins	1,400
264	Thermoset Wastes	Urea-formaldehyde and Thermoset Wastes	1,400
29	OILY WASTES		
281	Waste Oil and Mixed Oil	Used Automotive Oil, Hydraulic Oil, Cutting Oil - May Contain Solvents or Metals	46,500
282	Oily Tank Bottoms	Crude Oil or Sludge from Storage	29,300
283	Oily Mud, Sediment and Water	Crude Oil Tanker Cleaning	49,300
284	Oily Acidic Solids	Solids from Emulsion Breaking and Re-Refining	10,400
285	Oily Alkaline Solids	Refining Solids	6,300
286	Oil/Water Separator Sludge	Oil Cooled Heavy Inorganics	5,200

UCD WASTE	DESCRIPTION	TYPICAL WASTES	Estimated Waste Quantity (tonnes)
288	Oily Wastes with Heavy Metal Contaminants	Steel Rolling Mill Sludges and Mill Scale	169,200
289	Oily Wastes with Water	Emulsions, Cleanup Water from Garages, Cooling Waters	100
41 RELATIVELY INERT SLUDGES			
416	Ink Sludge	Sludge Could Contain Solvents, and Lead, Cesium, Chromium	4,100
417	Alum and Gypsum Sludges	Waste Water Phosphate Removal Sludge	1,100
43 METAL SLUDGES			
431	Heavy Metal Sludge	Similar to that in 111, 113, 121, 123, 132, 133, 141	43,800
433	Other Metal Sludges	Ferric Chloride, Aluminum Oxide, etc.	9,200
44-45 OTHER SLUDGES			
441	Lime Sludges	From Treatment of Acids and Similar to 431 and Derived from 111, 113, 121, 123, 131, 132, 133, 141	81,700
443	Sulfur Sludge	Desulfurization of Flue Gas; Non-reactive but Very Low Bearing Strength	1,800
444	Cyanide Bearing Sludge	Pot Liners from Aluminum Reduction and Scrubber Sludge from Blast Furnace	27,400
445	Plating or Metal Finishing Sludge	Derived Mostly from 131, 132, 133	6,800
446	Degreasing Sludge	Grease and Oily Soil Containing Trichloroethane (TCE)	29,500
447	Tetraethyl Lead Sludge	Tank Bottoms	< 100
454	Paint Sludge	Drum Bottoms, Spills, Cleanup, etc.	30,500
455	Paint Sludge Without Heavy Metals	Mostly Latex	7,600
50-53 MISCELLANEOUS			
509	Gas Cylinders or Containers	Oxygen Cylinders - Empty	100
512	Spill Cleanup	Oil/Soil Mixture	2,100
513	Laboratory Waste Chemicals	Partially Full Small Containers	1,000
518	Dust Collector Wastes	Dry Lime from Dust Control Bagnouse	88,500
521	Spent Cartridge Filters	Air Cleaning Filters on Ventilation System	< 100

UCD WASTE	DESCRIPTION	TYPICAL WASTES	Estimated Waste Quantity (tonnes)
523	Tank Bottom Sediments	Some may Contain Flammable Organics	1,500
528	Pathological Wastes	Hospital Wastes-Used Bandages, Dressings	2,000
529	Explosives Wastes		< 100
531	Contaminated Rags	Cleanup Materials	300
532	Equipment and/or Containers Contaminated with Pesticides	Empty Pesticide Cans	1,800
TOTAL WASTES			1,490,300

UCD 133	Spent Pickle Liquor	(14.3%)
288	Oily Wastes with Heavy Metals	(11.3%)
111	Acidic Solutions with Heavy Metals	(10.0%)
151	Inorganic Solids	(8.9%)
152	Inorganic Chemicals	(8.9%)
283	Oily Mud, Sediment and Water	(4.6%)
518	Dust Collector Wastes	(3.8%)
123	Other Alkaline Solutions	(3.7%)
441	Lime Sludges	(3.5%)

While a UCD category is designed to show specific physical and chemical properties, it is difficult to totally eliminate overlap because the classifying of waste streams is subject to human interpretation. While there are many waste types, there are a number of cases where the respondent to any survey may choose from multiple applicable categories.

Because the person classifying the waste may have difficulty in differentiating among several UCD's, high generation rates may result by the use of multiple factors within an SIC. An example of this difficulty is a steel rolling mill that uses a strong mineral acid for mill scale pickling. Among the waste types that may describe the pickle liquor waste are UCD 111 - Acidic Solutions with Heavy Metals, UCD 133 - Spent Pickle Liquor, UCD 141 - Other Aqueous (Salt) Solutions with Heavy Metals or UCD 511 - Rinse Water and Wastewater.

If, in classifying this waste, one steel rolling mill selected UCD 111, a second chose UCD 133, a third UCD 141 and a fourth UCD 511, the model would show that four different types of liquid waste are produced within the industry when in fact the quantity of waste should be the average of these four.

Where the waste types can potentially overlap based on incorrect or ambiguous classification, the objective of the data analysis has been to reduce the number of categories and average those within the potential overlap.

6.4 Waste Generated by Category

As presented in Section 5, the UCD waste types have been grouped into 14 categories based on similarities of chemical and physical characteristics and treatment requirements. These categories and the estimated quantity of each generated are shown in Table 6-2.

Two categories together account for over half of the estimated waste generated. Heavy metal solutions and inorganic residuals total 574,300 tonnes (38.5% of total waste). This category includes spent plating or etching, rinse and less concentrated aqueous solutions, sludges from plating and etching lines and sludges from the treatment of solutions containing metals. A further 246,800 tonnes (16.6% of total wastes) are sludges and inorganic residuals including ash, foundry sands containing phenolics and spent catalyst.

It can also be seen from this table that of the total waste generated, 57.7% is in liquid form, 24.8% is in solid form and 17.5% is in sludge form. While neither sludge nor solid wastes offer much scope for on-site volume reduction, liquids do have the potential to be reduced substantially before being sent to a waste treatment facility. Preliminary analysis indicates that on-site treatment of liquid waste could reduce the quantity requiring special treatment by almost 80%.

The wastes may also be characterized as being either organic or inorganic. Generally speaking, organic materials include hydrocarbons and their derivatives, whether of natural or synthetic origin, for example oils and solvents. Inorganic materials encompass substances of earthy or mineral origin, for example sand and metals. Table 6-3 summarizes the estimate of waste generated according to the broad physical (solid-liquid-sludge) and chemical (organic-inorganic) characteristics.

TABLE 6-2

ESTIMATED WASTE GENERATED (1981)
BY WASTE CATEGORY AND PHYSICAL CHARACTERISTICS (TONNES)

WASTE CATEGORY	SOLID	LIQUID	SLUDGE	TOTAL	% OF TOTAL
Organic Sludges and Still Bottoms (no oil)	4,100	-	43,000	47,100	(3.2%)
Solvents and Organic Solutions	-	42,100	-	42,100	(2.8%)
Oils and Greases	-	51,000	-	51,000	(3.4%)
Oil/Water Mixtures	-	69,000	-	69,000	(4.6%)
Organic and Oily Residuals	17,300	169,400	34,700	221,400	(14.9%)
Heavy Metal Solutions and Residuals	-	514,700	59,600	574,300	(38.5%)
Miscellaneous Chemicals and Products	135,200	5,400	4,100	144,700	(9.7%)
Paint and Organic Residuals	11,700	-	38,300	50,000	(3.4%)
Aqueous Solutions with Organics	-	700	-	700	(0.0%)
Anion Complexes	-	7,400	27,400	34,800	(2.3%)
Sludges and Inorganic Residuals	192,400	-	54,400	246,800	(16.6%)
Pesticide and Herbicide Wastes	600	-	-	600	(< 0.1%)
PCB Wastes	200	-	-	200	(< 0.1%)
Clean-Up Residuals	7,600			7,600	(0.5%)
TOTAL	369,100	859,700	261,500	1,490,300	(100.0%)

TABLE 6-3

ESTIMATED WASTE GENERATED BY
PHYSICAL AND CHEMICAL NATURE
(TONNES X 1,000)

	Chemical		
Physical	Organic	Inorganic	Total
- Solids	35.3	333.8	369.1
- Liquids	244.8	614.9	859.7
- Sludges	93.3	168.2	261.5
TOTAL	373.4	1,116.9	1,490.3

6.5 Waste Generated by Industry Type

The industrial sources of waste generated in Ontario in 1981 are shown in Table 6-4 and illustrated in Figure 6-1. It can be seen that primary metal industries (51.5% of total wastes), chemical industries (9.9% of total waste) and fabricated metal products industries (8.4% of total waste) are the most significant waste generators. These three SIC's were the focus for the generator interviews undertaken in this study.

Other important industrial groups were machinery (except electrical); paper products, transportation equipment; and petroleum.

6.6 Waste Generated by Municipal Area

The industrial employment data base listed 990 towns and cities in Ontario with industrial establishments. These towns and cities have been grouped into 48 municipal areas, as shown in Figure 6-2. Appendix G presents a list of the 48 areas and their constituent towns and cities.

Table 6-5 presents the estimated waste generated in terms of the 14 categories by these 48 municipal areas. These data are also illustrated in Figure 6-3. As can be noted, the Toronto municipal area (from Scarborough through Oakville) is the source of 31% of all waste generated in Ontario. Hamilton, with 19.5% of all special waste, is the second most significant source, with Sault Ste. Marie, Kitchener and Windsor areas also being sources of significant waste quantities.

6.7 Waste Quantity Projections

To accurately project waste generation into the future is to be able to forecast three factors: industrial production, industrial innovation and industrial waste management practices.

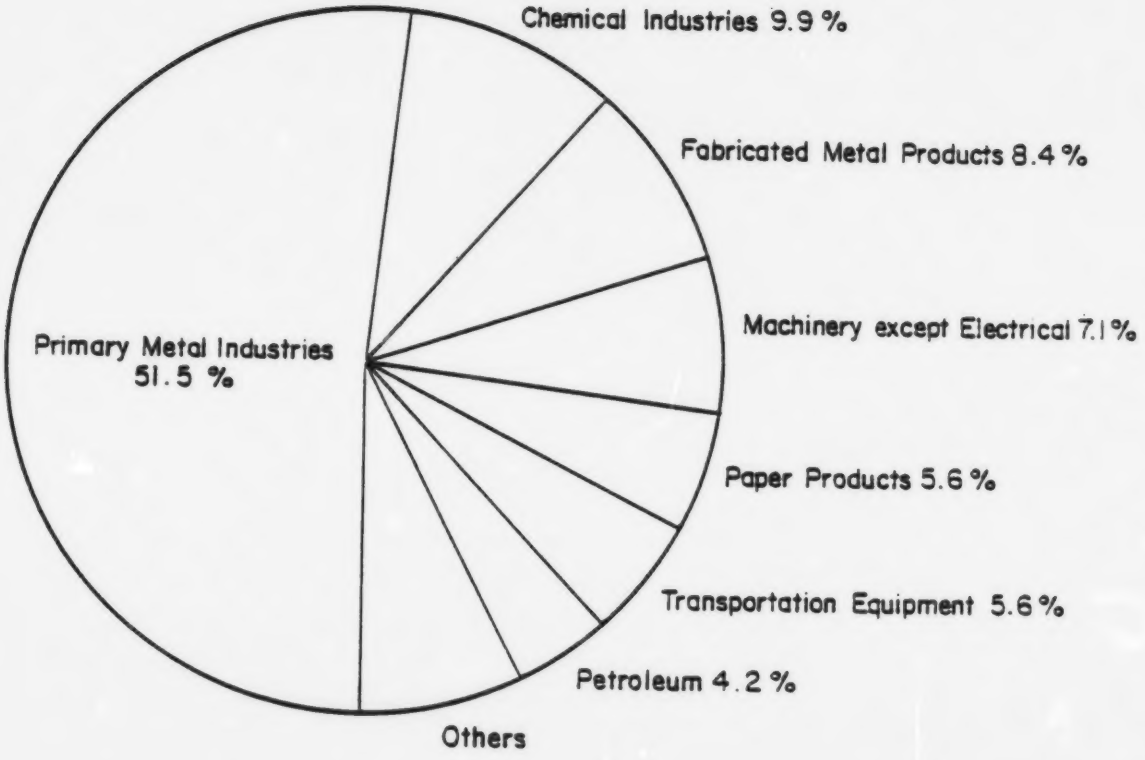
TABLE 6-4

ESTIMATED WASTE GENERATED BY INDUSTRY TYPE

(TONNES x 1000)

Industry \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oils & Greases	Oil/water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals and Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges and Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	TOTAL %
Primary Metal Industries	*	0.9	3.2	2.9	182.7	278.7	36.6	2.1	-	26.3	233.3	-	-	-	766.7	51.5
Chemical Industries	11.9	6.2	6.0	3.9	2.8	68.2	27.0	8.5	0.7	3.2	5.2	0.5	-	2.8	146.9	9.9
Fabricated Metal Products	0.2	1.2	1.7	4.7	1.5	101.2	*	9.5	-	4.2	1.0	-	-	-	125.2	8.4
Machinery Except Electrical	0.5	10.7	1.7	48.5	12.6	28.0	0.7	3.2	-	-	0.2	-	*	0.1	106.2	7.1
Paper Products	-	2.3	0.4	-	-	4.5	72.8	2.7	-	-	-	-	-	-	82.7	5.5
Transportation Equipment	28.1	0.5	6.7	2.1	0.7	32.6	0.1	11.3	-	-	0.5	-	-	-	82.6	5.5
Petroleum	0.5	0.6	29.0	*	9.9	19.4	*	1.5	*	-	1.5	-	*	0.3	62.8	4.2
Printing	-	2.1	0.4	0.8	0.2	13.9	2.8	*	-	-	-	-	-	0.3	20.5	1.4
Stone, Glass, Concrete	-	8.3	*	0.3	0.1	6.5	-	0.9	-	-	3.4	-	-	-	19.5	1.3
Electrical Machinery	0.1	0.3	0.5	5.6	1.4	6.7	0.2	0.5	-	0.7	0.2	-	*	*	16.2	1.1
Rubber & Plastics	2.9	3.4	0.6	*	0.7	1.1	0.1	0.5	-	-	1.3	-	-	2.1	12.7	0.9
Non-Bldg. Construction	-	-	0.1	-	8.7	-	-	-	-	-	-	-	-	-	8.9	0.6
Misc. Manufacturing	*	0.8	*	-	-	4.6	0.1	1.9	-	0.4	-	-	-	-	7.8	0.5
Food Products	0.9	1.6	0.2	-	*	0.8	4.2	-	-	-	*	-	-	-	7.7	0.5
Furniture	-	0.1	0.1	-	-	1.2	*	4.8	-	-	-	-	-	-	6.2	0.4
Measuring Instruments	0.6	1.2	0.2	*	*	2.4	*	0.6	-	-	0.1	-	-	-	5.2	0.3
Leather Products	1.0	*	-	-	-	1.9	-	-	-	-	0.1	-	-	-	3.0	0.2
Textiles	0.2	0.9	0.2	*	*	*	-	*	-	-	-	-	-	-	1.4	0.1
Lumber & Wood	-	0.4	*	-	*	0.7	*	0.1	-	-	-	0.1	-	-	1.4	0.1
Apparel	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.1
Hospitals	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	2.0	0.1
Other	-	0.2	*	*	*	1.9	*	1.9	-	-	-	-	*	-	4.1	0.3
TOTAL	47.1	42.1	51.0	69.0	221.4	574.3	144.7	50.0	0.7	34.8	246.8	0.6	0.2*	7.6	1490.3	100.0

* Waste Quantities less than 100 Tonnes
* PCB's Not Included in SIC Total
NOTE: Totals may not add due to rounding



100 % = 1,490,000 tonnes

ESTIMATED WASTE GENERATED BY INDUSTRY TYPE

FIGURE 6-1

LOCATIONS OF MUNICIPAL AREAS

FIGURE 6-2

TABLE 6-5

ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA (Cont'd)

(TONNES x 1000)

Municipality \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oils & Greases	Oil/Water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals and Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges & Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	TOTAL %
St. Thomas	1.4	.6	.3	.7	.3	2.4	•	.5	•	•	.1	•	-	•	6.2	0.4
Cobourg	.5	.4	.1	.3	.5	2.2	.6	.3	•	•	.6	•	-	•	5.5	0.4
Halton Hills	.4	.3	.1	.3	.4	2.5	•	.2	•	•	.1	•	-	.1	5.0	0.3
Stratford	.3	.2	.2	.7	.3	1.8	•	.5	•	•	.7	•	-	•	4.9	0.3
North Bay	•	.3	.1	.3	.6	2.5	•	.2	•	•	•	•	-	.3	4.5	0.3
Peterborough	•	.4	•	.5	.2	2.4	.1	.3	•	.1	.1	•	-	•	4.3	0.3
Sudbury	•	.1	.1	.3	.4	1.6	.3	.1	-	.1	.6	•	-	•	3.5	0.2
Grimsby	•	.2	•	.3	.1	2.1	.5	.1	•	•	•	•	-	•	3.3	0.2
Huntsville	•	.2	•	.1	.1	.3	.5	.3	-	•	.5	-	-	•	2.4	0.2
Lindsay	.1	.3	•	.1	.6	.3	•	.1	•	•	.5	•	-	•	2.0	0.1
Owen Sound	.2	•	.1	.2	.1	1.3	•	.1	-	-	•	-	-	•	2.0	0.1
Dunnville	•	•	•	.1	.1	.8	.2	•	-	.2	.1	•	-	•	1.6	0.1
Orangeville	•	.1	•	.2	.1	.8	•	.3	•	•	•	-	-	•	1.6	0.1
Kelkerton	•	•	•	.1	•	.6	•	•	-	•	•	-	-	-	.9	0.1
Other Northwest	•	.1	•	.1	.8	.5	9.5	.7	-	-	•	-	-	•	11.7	0.8
Other Southeast	.2	.3	.2	.3	1.6	1.4	.2	.5	-	.2	6.2	•	-	•	11.3	0.8
Other South Central	.1	.5	•	.5	.9	1.0	•	.2	-	•	.1	-	-	•	3.4	0.2
Other Southwest	•	.1	•	.3	.3	1.0	•	.2	•	•	•	•	-	•	2.1	0.1
Other Northeast & Central	.1	.2	•	.2	.1	.2	.4	.4	-	-	•	-	-	-	1.7	0.1
Total	47.1	42.1	51.0	69.0	221.4	574.3	144.7	50.0	0.7	34.0	246.8	0.6	0.2*	7.6	1490.3	100.0

• Quantities less than 100

* PCB's Not Included in Municipal Totals

NOTE: Totals may not add due to rounding

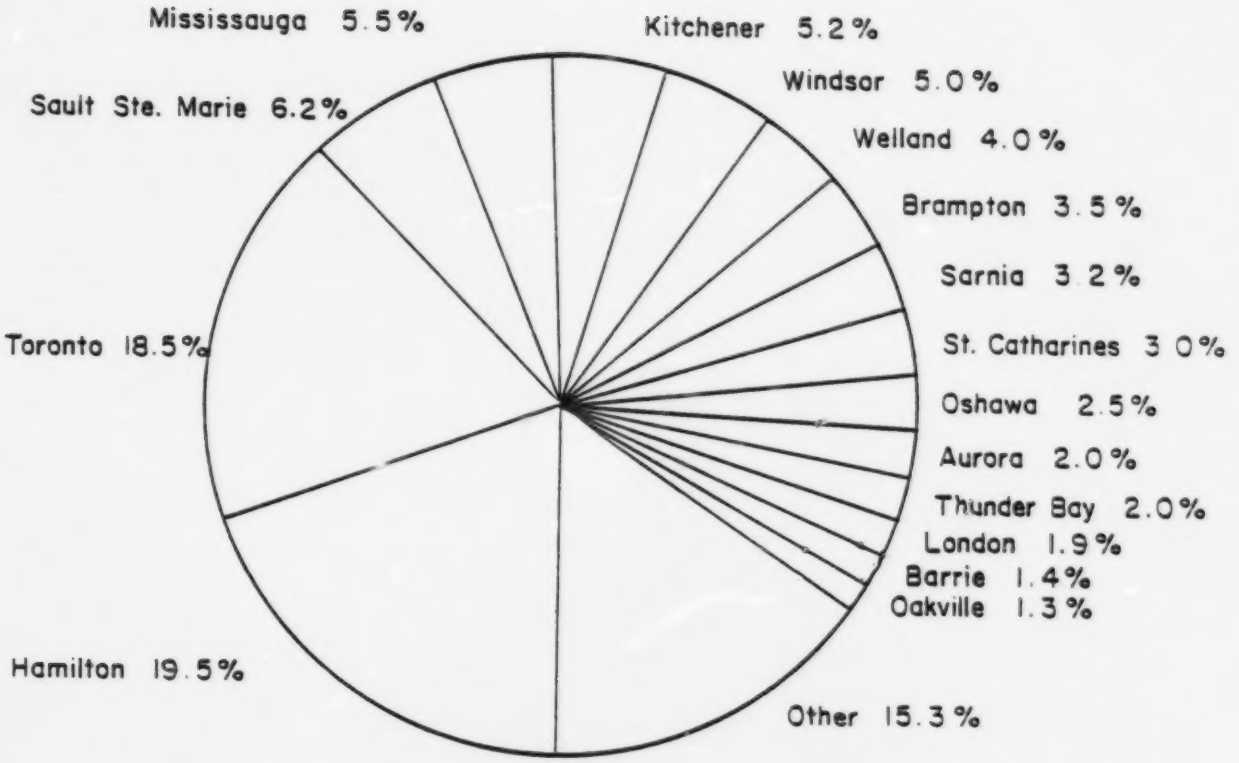
TABLE 6-5

ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA

(TONNES x 1000)

Municipality \ Waste Category	Organic Sludges & Still Bottoms	Solvents & Organic Solutions	Oil & Greases	Oil/Water Mixtures	Organic & Oily Residuals	Heavy Metal Solutions and Residuals	Miscellaneous Chemicals & Products	Paint & Organic Residuals	Aqueous Solutions With Organics	Anion Complexes	Sludges and Inorganic Residuals	Pesticides & Herbicide Wastes	PCB Wastes	Cleanup Residuals	TOTAL Tonnes x 1000	%
Hamilton	1.7	1.9	1.7	4.0	36.2	94.8	20.6	2.4	*	16.8	109.6	*	-	.3	290.0	19.5
Toronto	10.8	13.9	6.8	21.7	31.7	137.7	19.3	16.4	.2	2.4	12.1	.1	*	1.5	274.6	18.4
Sault Ste. Marie	*	.1	.4	.4	10.0	21.3	11.1	.4	-	6.2	43.0	*	-	*	92.9	6.2
Mississauga	1.9	4.2	3.6	6.6	19.9	34.5	4.3	3.7	*	.8	2.5	.1	*	.3	82.4	5.5
Kitchener	1.9	2.5	1.2	4.4	21.3	33.8	.6	1.8	.1	.6	6.8	*	-	2.4	77.5	5.2
Windsor	6.6	1.3	3.4	4.1	35.1	15.5	3.3	2.3	-	.2	1.9	*	-	.2	73.9	5.0
Welland	*	.7	.2	1.2	5.6	33.4	2.0	.4	*	1.8	14.5	*	-	.1	59.9	4.0
Brampton	1.5	1.6	.5	2.0	17.8	21.5	3.0	1.3	.1	.2	2.1	*	-	.2	51.8	3.5
Sarnia	.5	1.3	16.5	.5	6.3	18.3	.7	.8	.1	.6	1.6	.1	-	.9	48.2	3.2
St. Catharines	1.6	1.1	.7	2.1	3.3	11.9	13.5	1.7	*	.3	8.6	*	-	*	44.8	3.0
Oshawa	8.6	1.4	.8	1.9	2.9	12.5	1.4	2.5	*	.6	3.8	*	-	.2	36.8	2.5
Aurora	.5	.8	2.5	2.0	1.3	19.0	.8	1.3	*	.2	.8	*	-	.1	29.5	2.0
Thunder Bay	*	.1	.1	.3	.3	3.5	23.5	.8	*	.1	.5	*	-	*	29.2	2.0
London	.3	1.0	2.4	2.0	2.4	14.1	1.3	1.4	*	.5	2.9	*	-	.1	28.4	1.9
Barrie	.4	.9	.2	1.1	2.0	6.6	.5	.6	*	*	8.4	-	-	.1	20.8	1.4
Oakville	3.6	.5	1.9	.9	1.6	8.7	.5	1.2	*	.2	.4	*	-	.1	19.6	1.3
Cornwall	.1	.5	2.4	.3	.6	3.2	8.3	.5	*	.1	.3	*	-	.1	16.5	1.1
Guelph	.1	1.0	.2	1.2	2.7	8.9	.3	.4	*	.2	1.2	-	*	*	16.3	1.1
Ottawa	.5	.5	.2	1.1	1.2	8.3	1.1	.7	*	.5	1.5	*	-	.1	15.7	1.1
Simcoe	*	*	.1	.2	2.9	5.4	.9	*	-	.9	4.8	*	-	-	15.2	1.0
Kingston	*	.4	1.3	.4	2.4	5.7	.1	.4	*	*	3.7	*	-	*	14.4	1.0
Cochrane	-	.1	.1	.1	.4	.5	12.2	.3	-	-	*	-	-	*	13.7	0.9
Woodstock	.6	.6	.4	1.0	.4	6.8	.1	1.0	*	.1	1.0	*	-	*	12.0	0.8
Chatham	1.3	.3	.6	.6	1.0	5.6	.5	.6	-	.2	1.0	*	-	*	11.8	0.8
Kirkland Lake	*	*	*	.2	2.8	3.8	.5	.1	-	.3	2.0	*	-	*	9.7	0.7
Brantford	.4	.6	.2	1.1	.6	3.8	1.3	1.3	*	*	.2	*	-	*	9.5	0.6
Brockville	.1	.2	1.2	.7	.5	4.3	.3	.3	-	*	.7	-	-	*	8.3	0.6
Belleville	.3	.3	.1	.5	.2	4.2	.2	.4	*	.1	.3	*	-	.1	6.9	0.5

* Quantities Less than 100
* PCB's Not Included in Municipal Totals
NOTE: Totals may not add due to rounding



100% = 1,490,000 tonnes

ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA

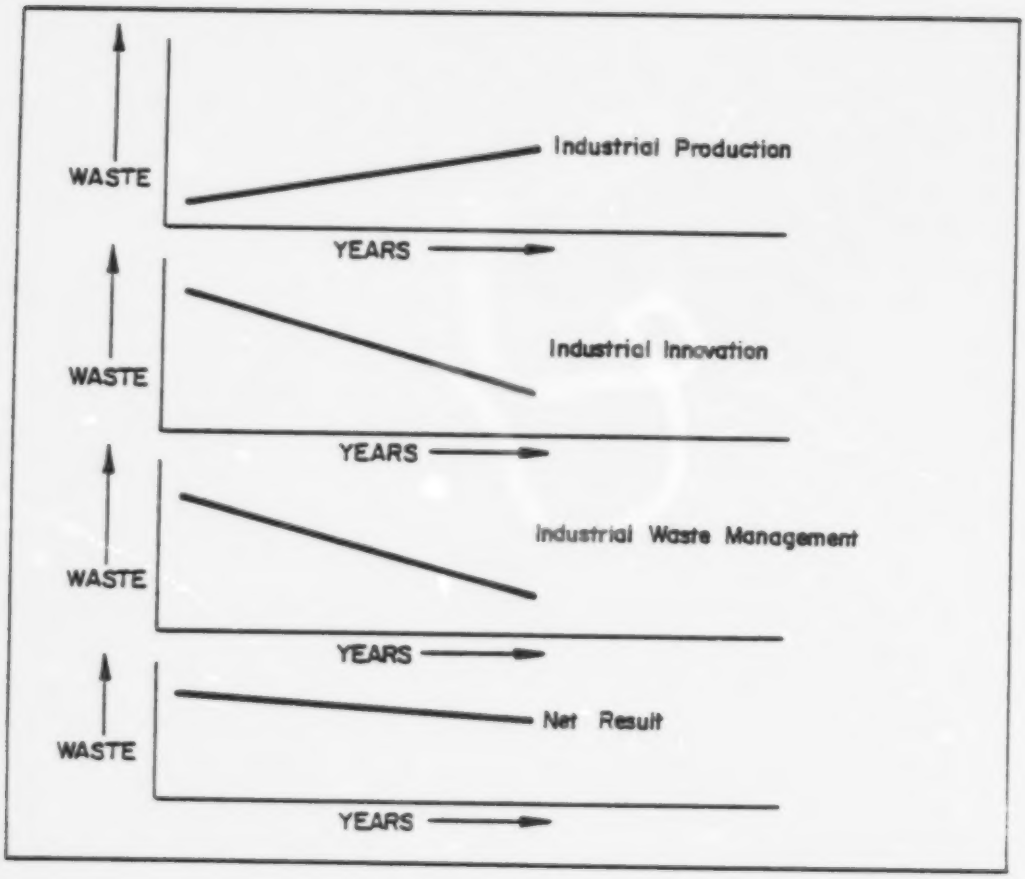
FIGURE 6-3

Under a given set of industrial processes, the amount of waste generated is a function of production. All that can accurately be predicted is that the future will bring continued cycles of economic expansion and recession. While several government and private agencies produce economic forecasts, they generally prove reasonably accurate for only 6 - 12 months into the future; indeed, economic forecasts have changed considerably over the period during which this study was conducted. It is believed, however, that industrial production will increase slowly over the next 20 years.

Industrial innovation brings changes in production processes, which yield changes in waste generated per unit of output. As waste becomes an increasingly important cost factor, it can be expected that new processes will incorporate waste prevention or reduction. This factor will be especially notable in those industrial sectors that are being modernized or for which advanced technology is applicable. In general, industrial innovation will result in reduced quantities of waste being generated.

Industrial waste management is a continuous activity that responds to changes in waste management and environmental regulations, raw material costs and waste treatment costs. As raw material costs increase, reuse, recycling and waste exchange become more prevalent. Increasing waste treatment costs also spur reuse, recyclying and exchange of wastes as well as on-site treatment and process changes. While some waste treatment facilities may receive wastes that can be reused or recycled, as raw material and treatment costs increase, the wastes received will be only that waste for which no industry has a use. Industrial waste management practices will therefore seek to minimize waste production in the future.

The above factors are illustrated in Figure 6-4. The net result of the interplay of these factors will be a slow decline in the total amount of waste generated in Ontario.



FUTURE TRENDS IN WASTE GENERATION

FIGURE 6-4

7.0 COMPARISON WITH OTHER SURVEYS

7.1 General

Given the broad public interest in the question of the hazardous waste "problem" and the number of surveys undertaken recently to quantify the amount of waste generated in Ontario, it is likely that the estimates contained in this report will undergo considerable scrutiny and comparison with other surveys.

The following paragraphs and tables attempt to compare recent surveys undertaken of Ontario's waste.

7.2 Other Surveys

Table 7-1 presents a review of five recent hazardous waste surveys undertaken in Ontario. The purpose, methodology and geographic coverage of each survey are presented. These surveys have now all been completed and the results have been subjected to review.

The survey results and other pertinent areas of comparison are shown in Table 7-2. It should be noted that the Regional Municipality of Waterloo and Reid, Crowther surveys did not cover all of Ontario.

Of the remaining three surveys, The Canadian Chemical Producer's Association co-ordinated survey did not include all industries nor did it report on all firms within the industries it did survey.

The present study can only appropriately be compared with the results of the Gore & Storrie survey carried out for Environment Canada. As can be seen in Table 7-2, the waste quantities estimated for Ontario by these two surveys are within 10% of each other: 1,490,300 tonnes (this survey) vs. 1,600,000 tonnes (Gore & Storrie). The most significant difference between the two surveys is that the Gore & Storrie survey was solely

TABLE 7-1

LIQUID INDUSTRIAL WASTE AND/OR HAZARDOUS WASTE INVENTORIES UNDERTAKEN FOR ONTARIO

INVENTORY	STATUS	PURPOSE	METHODOLOGY	GEOGRAPHIC COVERAGE	COMMENTS
1. WASTE QUANTITIES STUDY BY: Proctor & Redfern Ltd. Ontario Research Foundation Weston Designers - Consultants For: Ontario Waste Management Corporation	Start Date: November 1981 Completion: September 1982	To estimate liquid industrial waste and hazardous waste generation in Ontario by quantity, type and location	• Liquid industrial waste and hazardous waste generation factors were applied to Standard Industrial Classification (SIC) base data (eg. number of employees, plant size and number). The exercise yielded an estimate of tonnes per year of waste generated in Ontario. • A waste classification system, based on the University of California at Davis (UCD) Waste Categories was utilized, with revision, to estimate waste by type. • A ground truthing activity was conducted with industries in Ontario to supplement and refine data previously generated	The Province of Ontario by municipality and further geographic delineation as required	• Study is designed to provide input into systems design, treatment technology selection and other related studies. • A 'live file' of data will be maintained to update study as required.
2. ONTARIO INDUSTRIAL HAZARDOUS WASTE SURVEY By: The Canadian Chemical Producers' Association (CCPA) and The Canadian Manufacturers Association (CMA) For: Ontario Ministry of the Environment	Start Date: August 1981 Completion: December 1981	• To assist the Ministry of the Environment in estimating the quantity and nature of industrial hazardous wastes. This information was to assist in determining: - what waste treatment facilities will be required, and - what wastes will be accepted at the then proposed Cayuga site	• A questionnaire was distributed by Ontario trade associations representing firms with manufacturing facilities. • Completion and return of questionnaire was voluntary and results were compiled by member associations and reported as a composite of the total industrial sector. • Respondents were requested to identify only hazardous wastes based on Resource Recovery and Conservation Act (RCRA) definitions and listings	Aggregate quantities for Ontario	• Returns aggregated by individual trade associations. Backup data considered confidential and therefore not available • Response rate varied considerably depending on trade association. • Inventories hazardous waste quantities based on U.S. RCRA definitions

TABLE 7-1 (CONTINUED)

LIQUID INDUSTRIAL WASTE AND/OR HAZARDOUS WASTE INVENTORIES UNDERTAKEN FOR ONTARIO

INVENTORY	STATUS	PURPOSE	METHODOLOGY	GEOGRAPHIC COVERAGE	COMMENTS
3. REGIONAL MUNICIPALITY OF WATERLOO LIQUID AND SPECIAL WASTE INVENTORY By: Canviro Consultants & Simcoe Engineering For: Ministry of the Environment, Environment Canada, City of Kitchener, Regional Municipality of Waterloo	Start Date: July 1981 Completion July 1982	• To determine quantities, types and the fate of liquid industrial and special wastes in the Regional Municipality of Waterloo	• A telephone survey of 455 industries in the Waterloo region was undertaken using a standard questionnaire. Fifty-eight on-site interviews conducted. • Survey of major haul/disposal companies • Waste classification system developed by project team and steering committee on the basis of waste streams identified in survey.	Regional Municipality of Waterloo	• Waste Classification System does not appear compatible with those used in other inventories. • Includes 6 major waste classes and 41 sub-categories.
4. CANADA NATIONAL INVENTORY OF HAZARDOUS AND TOXIC WASTES By: Gore & Storrie Ltd. For: Environment Canada/ Environmental Protection Service	Completion: January 1982	The development of a national inventory of hazardous and toxic wastes for use by federal and provincial agencies	• Application of hazardous waste generation factors to SIC data to produce annual volumes of hazardous waste (tonnes) • Utilize U.S. EPA listing of hazardous wastes as classification system. • Waste quantities grouped by type in following categories: - chemical and allied products industry, - primary metal and fabricated metal products industry - all other SIC industry groups	Canada - by first three character postal code zone	• Only hazardous and toxic wastes inventoried per RCRA definition • EPA classification system designed as an aid for regulation rather than for design purposes.

TABLE 7-1 (CONTINUED)

LIQUID INDUSTRIAL WASTE AND/OR HAZARDOUS WASTE INVENTORIES UNDERTAKEN FOR ONTARIO

INVENTORY	STATUS	PURPOSE	METHODOLOGY	GEOGRAPHIC COVERAGE	COMMENTS
5. HAZARDOUS WASTES IN NORTHERN AND WESTERN CANADA By: Reid, Crowther & Partners Ltd./Bissel & Associates/SCS Engineers For: Environment Canada in association with British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Yukon, Northwest Territories.	Start Date: March 1979 Completion: February 1980	To upgrade existing Hazardous Waste Inventory information in the Study Area utilizing available sources.	• Application of unit waste generation rates per production employee (firms with 4 employees or greater) to U.S. SIC data (20) groups) on location, types, and sizes of industry. • Waste streams placed into 40 waste categories, based on published information on waste types within the study region.	Northern and Western Canada and North Western Ontario by first three character postal code	• Data for North Western Ontario included only four postal code regions. Thunder Bay only major municipality within study area. • Information limited to hazardous waste streams.

TABLE 7-2

COMPARISON OF WASTE ESTIMATES

Source of Estimate / Factor	Proctor & Redfern	Cdn. Chemical Producers' Assn.	Gore & Storrie	Reg. Mun. of Waterloo	Reid, Crowther
Type of Waste Included*	H,LI	H	H	H,LI	H
Year Data Estimated For	1981	1980	1981	1981	1979
Geographic Coverage	Ontario	Ontario	Ontario	Reg. Mun. of Waterloo	N.W. Ontario
Total Waste Generated (Tonnes)	1,490,300	540,000	1,600,000	230,000	4,400
Industries Included	All	Some	All	All	All
Firms in Each Industry Included	All	Some	All	All	All
Waste Classification System	UCD	RCRA	RCRA	Unique	Unique
Data on Waste Source Location	Yes	No	Yes	Yes	Yes
Data on SIC Source of Waste	Yes	No	Yes	Yes	Yes
Methodology:					
Model	Yes	No	Yes	No	Yes
Survey	Yes	Yes	No	Yes	No
Per Capita Waste Generated (Tonnes)	0.175	0.063	0.188	0.751	0.022

* H = Hazardous Waste LI = Liquid Industrial Waste

based on a generation factor model whereas in this study the accuracy of the generation factors was increased by the series of 100 interviews in key waste generating industries.

As a check on the estimates produced in this report, comparative data for 18 other jurisdictions was derived from literature searches and discussions with local officials. Table 7-3 presents a list of waste generated per manufacturing employee. The results of this report (1.773 tonnes/ employee) fit well within the main group of estimates. It is interesting to note that this Ontario estimate is quite close to estimates of states with similar industrial mixes (Ohio, California, New York and New Jersey).

TABLE 7-3

ESTIMATES OF WASTE GENERATED PER MANUFACTURING EMPLOYEE DERIVED FROM REPORTED WASTE GENERATION QUANTITIES

Jurisdiction	Waste/Employee (Tonnes)	Type of Waste
Georgia	78.500	H
Ohio	3.812	H
United States	2.909	H
California	2.590	H,LI
ONTARIO	1.773	H,LI
Missouri	1.470	H,LI
New Jersey	1.020	H,LI
Maine	0.978	H
Connecticut	0.965	H
New York	0.721	C
New Hampshire	0.590	H
Vermont	0.582	H
Massachusetts	0.309	H
South Carolina	0.290	H
Rhode Island	0.274	H
Oregon	0.094	H

*Waste Type:
H = Hazardous
LI = Liquid Industrial
C = Chemical Wastes Requiring Special Handling

APPENDIX A

GLOSSARY OF TERMS

ACID WASTE	Generally an aqueous waste having a pH below 2. The waste may contain suspended or filterable solids. The aqueous portion or effluent is normally discharged to a sewer or directly to a waste water treatment plant for treatment.
ALKALI WASTE	A caustic, corrosive liquid waste, such as lye, with a pH greater than or equal to 12.5.
AQUEOUS WASTE	A waste stream which is predominately contaminated water.
CORROSIVITY	Tending or having the power to wear away gradually by chemical action; usually has a very high or very low pH value. May cause skin reaction on contact. See acid waste and alkali waste.
EFFLUENT	Primarily wastewater which can be discharged directly to a sewer or a water pollution control plant without pre-treatment.
FLY-ASH	Particulate matter removed from combustion flue gases.
HALOGEN	The nonmetals: fluorine, chlorine, bromine, iodine, and astatine. Each is an exceptionally reactive element. Halogens exhibit a valence of -1.
HAULED LIQUID INDUSTRIAL WASTE	Liquid waste, other than hauled sewage, that results from industrial processes or manufacturing or commercial operations and that is transported in a tank or other container for treatment or disposal; includes sewage residue form sewage works that are subject to the provisions of the Ontario Water Resources Commission Act. Source: R.R.O. 1980, Reg. 309.
HAULED SEWAGE	Waste removed from: - cesspool - septic tank system - privy vault or privy pit - chemical toilet - portable toilet, or - sewage holding tank Source: R.R.O. 1980, Reg. 309.
HAZARDOUS WASTE	Waste that requires special precautions in its storage, collection, transportation, treatment or disposal, to prevent damage to persons or property; includes explosive, flammable, volatile, radioactive, toxic and pathological waste. Source: R.R.O. 1980, Reg. 309.

INCINERATOR ASH	The ash residue, other than fly-ash, resulting from incineration where the waste is reduced to ashes containing by weight less than 10 per cent of combustible materials.
INCINERATION WASTE	The residue from incineration, other than incinerator ash and fly-ash.
INFECTIOUS	Capable of transmitting diseases caused by pathogenic organisms.
IGNITABILITY	Tending to be easily ignited or set afire; if liquid - possesses a low flash point temperature; if solid - liable to cause fire by friction, spontaneous chemical changes. These wastes are mainly organic solvents but may include oils, pesticides and plasticizers.
LIQUID	Refers to hazardous wastes which are "pumpable" under normal conditions.
NONPOINT SOURCE	Where contaminants enter the receiving surface water in intermittent and/or diffuse ways.
ORGANIC	Being, containing, or relating to carbon compounds, especially those in which hydrogen is attached to carbon, whether derived from living organisms or not.
pH	Expresses the acidity or alkalinity of solutions. A pH of 7 is neutral, less than 7 is acidic and greater than 7 is alkaline.
POINT SOURCE	Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, or concentrated animal feeding operation from which contaminants are or may be discharged.
REACTIVITY	Tendency to be unstable and readily undergo violent chemical change; may be capable of detonation or explosive reaction.
SIC	Stands for "Standard Industrial Classification" which is a recognized two to four digit number that classifies industries by product line.
SLUDGE	A "non-pumpable" waste usually generated from wastewater treatment, water supply treatment and production processes but could also be produced by some air pollution control equipment.
SOLID WASTE	Any garbage, refuse, sludge, or other discarded solid, semi-solid or contained gaseous material resulting from industrial, commercial, mining, agricultural and community activities.
SOLVENT	A substance capable of, or used in, dissolving or dispersing one or more other substances.

TOXICITY	The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.
TRANSFER STATION	A waste disposal site used for the purpose of transferring waste from a collection vehicle to another carrier for transportation to another waste disposal site.
WASTE EXCHANGE	System for waste information sharing between generators and other firms to facilitate the transfer of wastes to firms that can use the wastes as raw materials. The Canadian Waste Materials Exchange operates a waste exchange throughout Canada including Ontario.
WAYBILL SYSTEM	Provincial procedure for tracking liquid industrial wastes transported on public roads from a generator to a facility; shipping documents must be signed at each management step and then filed with the Ministry of the Environment. The Regulation governing transfers of liquid industrial waste is Ontario Regulation 926/76.

APPENDIX B

BIBLIOGRAPHY

Barr Engineering Company, Tenech Environmental Consultants, Inc., Nobe and Associates, Peat Marwick, Mitchell & Co., Dayton Herman Granam and Getts. Hazardous Waste Management - Minnesota's Issues and Options.

Booze-Allan & Hamilton, Inc. and Putnam, Hayes & Barlett, Inc., 1980. Hazardous Waste Generation and Commercial Hazardous Waste Managment Capacity - An Assessment. U.S. Environmental Protection Agency. SW-894

Cargo, D.B., 1978. Solid Wastes: Factors Influencing Generation Rates. The University of Chicago Department of Geography Research Paper No. 174.

Chau, P. et al, 1981. Hazardous Waste Generation and Off Site Disposal Patterns in California. University of California, Davis: California U.S.A.

Dominion Bureau of Statistics, 1970. Standard Industrial Classification Manual. The Ministry of Industry, Trade and Commerce, Ottawa.

Dun and Bradstreet, 1980. Canadian DMI Magnetic Tape Description. Dun and Bradstreet, Marketing Services Division, Toronto.

Dun and Bradstreet, 1980. Guide to Canadian Manufacturers. 4 Volumes. Howard and Smith Limited, Toronto.

Environment Canada, Environmental Protection Service, 1975. Characterization of the Industrial Wastes Generated in the Manufacturing of Organic Coatings, Pharmaceuticals and Medicinals Disposed in Ontario Landfills.

Environmental Protection Service, 1979. City of Vancourver Industrial Waste Inventory, 1977. E.P.S. Pacific Region, Regional Program Report.

Environmental Protection Service, 1980. Hazardous Wastes Inventory Report. E.P.S. Atlantic Region.

Executive Office of the President, Office of Management and Budget, 1972. Standard Industrial Clasification Manual. U.S. Government Printing Office.

GCA Corporation, Technology Division, 1980. Industrial Waste Survey for the State of Illinois - Final Report. Bedford, Massachusetts.

GCA Corporation, Technology Division, 1980. Investigation and Classification of Waste Types by SIC Codes - Volumes I and II. Bedford, Massachusetts.

Gore & Storrie Limited, 1982. Canadian National Inventory of Hazardous and Toxic Wastes, Volumes 1, 2, and 3. Prepared for Environment Canada/Environmental Protection Service, Ottawa, Ontario.

Iannotti, J.E., Knapp, B. Ind., Quackenbush, 1979. An Inventory of Industrial Hazardous Waste Generation in New York State. New York State Department of Environmental Conservation, Albany, New York.

Konan, A.M., 1975. A Summary of Hazardous Substance Classification Systems. U.S. Environmental Protection Agency. NTIS/PB-261 086.

Lemman, J.P., 1976. Federal Surveys of Industrial Waste. U.S. Environmental Protection Agency. EPA-545.

MacLaren, James F. Limited, 1979. Development of Treatment and/or Disposal Sites for Liquid Industrial Wastes and Hazardous Wastes. Prepared for the Ministry of the Environment.

MacLaren Engineers Planners & Scientists Inc., 1980 The Siting of Facilities and the Management of Liquid Industrial and Hazardous Wastes in Ontario. Prepared for the Ministry of the Environment.

Mitre Corporation, 1980. Final Environmental Impact Statement - Part 1 for Subtitle C, Resource Conservation and REcovery Act of 1976. 2 Volumes. Prepared in cooperation with the U.S. Environment Protection Agency. NTIS/PB81-114191, PB81-114209.

New York State Department of Environmental Conservation, Division of Solid Waste Management, 1979. Industrial Hazardous Waste Generation in New York State. Albany, New York.

Petroleum Association for the Conservation of the Canadian Environment, 1980. Can. Petroleum Refining Industry Waste Survey. Ottawa, Ontario.

Porter, C.H., 1975. State Program Implemtnation Guide: Hazarous Waste Surveys. U.S. Environmental Protection Agency. SW-160.

Pritchard, R., 1977. Survey of Liquid Wastes in City of Edmonton Landfills. Alberta Environment, Pollution Control Division.

Reed, L., and Smith, R., 1979. Edmonton Liquid Waste Study. Alberta Environment, Pollution Control Division.

Reid, Crowther & Partners Limited, 1980. Hazardous Wastes in Alberta, An Inventory and Review of Practices and Technology. 3 Volumes. Prepared for Alberta Environment.

Reid, Crowther & Partners Limited, 1980. Hazardous Wastes in Northern & Western Canada, The Need for a Waste Management Strategy. 3 Volumes. Prepared for Environment Canada.

Statistics Canada, 1974. Canadian-United States Standard Industrial Classification Convertibility Index. Standards Division, Statitistics Canada.

Statistics Canada, 1978. List of Canadian Hospitals and Related Facilities. Report No. 4-2301-511.

Synergy West Limited, 1975. Solid Waste Handling and Disposal in Alberta Hospitals. Prepared for Alberta Environment.

TRW Environemntnal Engineering Division, 1979. Technical Environmental Impacts of Various Approaches for Regulating Small Volume Hazardous Waste Generators - Pursuant to the Resource Conservation and Recovery Act of 1976, Volumes 1 and 2. Prepared for the United States Environemnt Protection Agency, Office of Solid Waste, Washington, D.C.

United States Environmental Protection Agency, Department of Water and Waste Management, 1980. Hazardous Waste Generation and Commercial Hazardous Waste Management Capacity - An Assessment. Washington, D.C.

Wapora Incorporated, 1977. Assessment of Industrial Hazardous Waste Practices - Electronic Components Manufacturing Industry. Prepared for Environmental Protection Agency. NTIS/PB-265 532.

Wardrop, W.L. and Associates Limited, 1979. Inventory of Hazardous Waste In the Northwest Region. Prepared for the Environmental Protection Service.

Wicks, P.H. and Synak, M., 1974. Oregon Surveys Its Hazardous Wastes. Environmental Science & Technology. Vol. 8, No. 13, page 1080.

APPENDIX C

UNIVERSITY OF CALIFORNIA AT DAVIS (UCD)

WASTE CLASSIFICATION DESCRIPTION

APPENDIX C

UNIVERSITY OF CALIFORNIA AT DAVIS (UCD) WASTE CLASSIFICATION SYSTEM

UCD WASTE CATEGORY	DESCRIPTION
INORGANICS	
(11) ACIDIC SOLUTIONS	Typically hydrochloric acid (HCl), sulfuric acid (H_2SO_4), or nitric acid (HNO_3).
(111) Acidic solutions with heavy metals	Including antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, indium, lead, manganese, mercury, molybdenum, nickel, selenium, silver, tin, vanadium, and/or zinc.
(112) Acidic solutions with other metals and non-metals	Typically contain an alkali metal, i.e. sodium (Na), potassium (K).
(113) Other acidic solutions	Acidic solutions not containing metals or non-metals.
(12) ALKALINE SOLUTIONS	Usually contain sodium hydroxide (NaOH), potassium hydroxide (KOH), or ammonium hydroxide (NH_4OH).
(121) Alkaline solutions with heavy metals	See (111) above.
(122) Alkaline solutions with other metals and non-metals	See (112) above.
(123) Other alkaline solutions	Alkaline solutions not containing metals or non-metals.
(13) METAL-FINISHING SOLUTIONS	From process identification on manifest, i.e. 'metal plating', 'pickling bath', etc.
(131) Metal-finishing solutions - acidic	Typically containing copper, tin, lead, or cadmium
(132) Metal-finishing solutions - alkaline	See (131) above.
(133) Spent pickle liquor	Acids typically containing iron, fluoride, hydrochloric acid, sulphuric acid, nitric acid.
(14) OTHER AQUEOUS (SALT) SOLUTIONS	Acidic or basic solutions which are neutralized by generator, yielding a salt solution
(141) Other aqueous (salt) solutions with heavy metals	See (112) above.
(142) Other aqueous (salt) solutions with other metals	See (113) above.
(143) Solution containing other reactive anions	Includes fluoride, hypochlorite, or bromate. Excludes cyanide or sulphide, or not stated.
* (144) Other aqueous solutions	Aqueous solutions(14) other than (141), (142), (143), (145), (146), or (147).
(145) Brine	
(146) Solution containing cyanide	
(147) Solution containing sulfide.	

*: Denotes Waste Types Deemed to be Outside OWMC Mandate and Hence Not Calculated

UCD WASTE CATEGORY	DESCRIPTION
(15) INORGANIC SOLIDS	
(151) Inorganic solids	Activated carbon, cement, etc.
(152) Inorganic chemicals	Miscellaneous salts, etc.
(16) OTHER INORGANIC WASTES	
* (161) Asbestos-containing wastes	
* (162) Aluminum or tin wastes	
(165) Spent catalyst	Typically silica-alumina or zeolite, containing trace metals and carbonaceous deposits.
(167) Unidentified inorganic wastes.	
ORGANICS	
21) SPENT SOLVENTS	
Halogenated Solvents	Contain chlorine (e.g. trichloroethylene), bromine, or fluorine.
(211) Spent solvents with heavy metals	See (111) above.
(212) Spent solvents with other metals	See (112) above.
(213) Other halogenated solvents, including mixed	Trichloroethylene, chloroform, carbon tetrachloride, etc.
Non-halogenated Solvents	Typically include oxygenates, e.g. acetone, methylethyl-ketone, etc.
(214) Spent solvents with heavy metals	See (111) above.
(215) Spent solvents with other metals or non-metals	See (112) above.
(216) Other non-halogenated solvents, including mixed	Solvents identified, and containing no metals
(217) Unspecified solvents	Alcohols and mixtures of solvents.
22) OTHER ORGANIC LIQUIDS	
(221) Other organic liquids with halogens and metals	See (112) above.
(222) Other organic liquids with halogens	Chlorine, bromine, fluorine only.
(223) Other organic liquids with heavy metal only	See (111) above.
224) Other organic liquids	Not classified as (221), (222), or (223).

*: Denotes waste types deemed to be outside CWMC mandate and hence not calculated

NCD WASTE CATEGORY		DESCRIPTION
(22)	ORGANIC RESIDUES	Frequently include such contaminants as chloroform, acetone, trichloroethylene, etc. These solutions commonly result from cleaning and degreasing operations.
	(225) Aqueous solution with non-halogenated organic residues < 10%	
	(226) Aqueous solution with halogenated organic residues < 10%	
	(227) Aqueous solution with non-halogenated organic residues > 10%	
	(228) Aqueous solution with halogenated organic residues > 10%	
(23)	ORGANIC SOLIDS	
	* (231) Organic solids with halogens	Polyvinyl.
	* (232) Organic solids without halogens	Polyethylene.
(24)	OTHER ORGANIC WASTES	
	(241) Pesticides and wastes	Pesticide production, waste and rinse water containing pesticides, and pesticide containers not clearly specified as empty.
	(242) Polychlorinated biphenyls (PCBs) and material containing PCBs	Transformer fluids, contaminated materials including transformer carcasses and soil.
	(243) Pharmaceuticals and wastes	
	(244) Photochemicals and wastes	Virtually all from photoprocessing laboratories.
	(245) Off-specification or aged organics	Miscellaneous.
	(247) Halogenated still bottoms	
	(248) Still bottoms (distillation residues) without halogens	
	(251) Liquid tannery wastes	Many components including, aqueous chromate solutions, and organic materials such as fat and hide.
	(252) Solid or sludge tannery wastes	
	* (253) Detergent and soap	Liquid, aqueous waste solutions, and organic solids from production or cleaning operations.
	(254) Adhesives or glue	
	* (255) Unspecified organic wastes	Organics not listed in above categories.
	(257) Phenolic wastes	
	(258) Waste tars and residues	
(26)	POLYMERIC MATERIAL AND WASTES	
	(261) Polymeric resin	Phenolic, epoxy, polyester, urethane, etc., per component data.
	(262) Latex and wastes	Paint, latex and acrylic resins.
	(263) Other polymeric wastes, thermoplastic, or not stated	Off-specification materials, crushed cases, discarded material from polymer reactors.
	(264) Other polymeric wastes, thermoset	

* Denotes Waste Types Deemed to be Outside CWMC Mandate and Hence Not Calculated

UCD WASTE CATEGORY		DESCRIPTION
(27)	BIOLOGICAL WASTES	
* (271)	Sewage sludge	
* (272)	Other biological wastes	Including animal fat, molasses wastes, and dough.
(28)	OILY WASTES	
(281)	Waste oil and mixed oil	May contain solvents or metals
(282)	Oily tank bottoms	Sludge
(283)	Oily mud or sediment and water	
(284)	Oily acidic solids	
(285)	Oily alkaline solids	
(286)	Oil/water separator sludge	
(288)	Oily wastes with heavy metal contaminants	
(289)	Oily wastes with water	See (111) above.
OTHER SLUDGES		
(41)	RELATIVELY INERT SLUDGES	
* (412)	Filter cake	Contaminated filter material, e.g. diatomaceous earth.
* (413)	Gas scrubber sludge	From gas cleaning operations.
(416)	Lime sludge	May contain solvents, lead, or chromium
(417)	Alum and gypsum (mineral) sludges	
(43)	METAL SLUDGE	
(431)	Heavy-metal sludge	See (111) above.
(433)	Other metal sludges	Typically contain salts of iron, aluminum and/or alkali metals.
(44)	OTHER SLUDGES	
(441)	Lime sludge	From neutralization processes; may contain heavy metals.
* (442)	Phosphate sludge	
(443)	Sulfur sludge	Includes sludge with high content of non-heavy metal sulfides.
(444)	Cyanide bearing sludge	
(445)	Plating or metal finishing sludge	See (431), (432), and (433).
(446)	Degreasing sludge	From cleaning of metal parts; contains solvents.

*: Denotes waste types deemed to be outside CWMC mandate and hence Not Calculated

UCD WASTE CATEGORY			DESCRIPTION
(44)	OTHER SLUDGES (continued)		
	(447)	Tetraethyl lead sludge	
*	(453)	Paper sludge/pulp	Paper and cardboard manufacture source
	(454)	Paint sludge	Many possible components, including heavy metal (chromium) and organic solvents or components not stated
	(455)	Paint sludge without heavy metals	
*	(456)	Other waste treatment sludge	Sludges not otherwise identified due to lack of composition data
*	(457)	Sludges with organic residues	Includes some halogenated components.
(50-53)	MISCELLANEOUS		
	(509)	Gas cylinders or containers	
*	(510)	Flue-gas scrubber liquid	
*	(511)	Rinse water and wastewater	Contains small units of oil, solvent, metals and/or mud; also bilge water.
	(512)	Spill clean-up	Includes miscellaneous organics, liquid fuels.
	(513)	Laboratory waste chemicals	
*	(514)	Contaminated soil and sand	
*	(515)	Drilling mud	
	(518)	Dust-collector wastes	Typically dry lime
*	(519)	Fly ash and retort ash	Combustion-generated particulates: mineral matter plus some carbon.
	(521)	Spent cartridge filters	Gas/liquid cleaning
	(523)	Tank bottom sediments	
*	(524)	Chemical toilet wastes	
*	(525)	Metal dust and machining wastes	Primarily ferrous and aluminum based alloys.
*	(526)	Cannery wastes	
*	(527)	Mud/sediment and water	
	(528)	Pathological wastes	
	(529)	Explosive wastes	
*	(530)	Contaminated pallets	
	(531)	Contaminated rags	
	(532)	Equipment and/or containers contaminated with pesticide	
*	(533)	Contaminated equipment and containers	Contaminants not stated
*	(535)	Totally unspecified wastes	Used only from California manifest purposes.

*: Denotes Waste Types Deemed to be Outside SWMC Mandate and Hence Not Calculated

APPENDIX D

UNITED STATES DEPARTMENT OF COMMERCE

STANDARD INDUSTRIAL CLASSIFICATIONS (SIC)

APPENDIX D

UNITED STATES DEPARTMENT OF COMMERCE STANDARD INDUSTRIAL CLASSIFICATIONS (SIC)

SIC	DESCRIPTION
16	CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION - GENERAL CONTRACTORS
1611	Hwy and Street construction excluding elevated highways
1622	Bldge, tunnel and elevated highway construction
1623	Water, sewer, pipe line, comm. & power line construction
1629	Heavy construction, nec.
20	FOOD AND KINDRED PRODUCTS
2011	Meat packing plants
2013	Sausages and prepared meat products
2016	Poultry dressing plants
2021	Creamery butter
2022	Cheese, natural and processed
2023	Condensed and evaporated milk
2024	Ice cream and frozen desserts
2026	Fluid milk
2032	Canned specialties
2033	Canned fruits, vegetables and preserves
2034	Dried and dehydrated fruits, vegetables and soup mixes
2035	Pickled fruits and vegetables, etc.
2037	Frozen fruits, fruit and vegetable juices
2038	Frozen specialties
2041	Flour and other grain mill products
2043	Cereal breakfast foods
2044	Rice milling
2045	Blended and prepared flour
2046	Wet corn milling
2047	Dog, cat and other pet food
2048	Prepared feeds and ingredients for animals and fowls nec.
2051	Bread and bakery products, excluding cookies
2052	Cookies and crackers
2061	Cane sugar, except refining only
2062	Cane sugar refining
2063	Beet sugar
2065	Candy and confectionery products
2066	Chocolate and cocoa products
2067	Chewing gum
2074	Cottonseed oil mills
2075	Soybean oil mills
2076	Vegetable oil, excluding corn, cottonseed and soybean
2077	Animal and marine fats and oils
2079	Edible fats and oils, margarine, etc.
2082	Malt beverages
2083	Malt
2084	Wines, brandy and brandy spirits
2085	Distilled, rectified, blended liquors
2086	Soft drinks and bottled waters
2087	Flavoring extracts and syrups, nec.
2091	Canned and cured fish and seafoods
2092	Fresh or frozen fish and seafoods
2095	Roasted coffee
2097	Manufactured ice
2098	Macaroni, spaghetti, noodles, etc.
2099	Food preparations, nec.
22	TEXTILE MILL PRODUCTS
2211	Broad woven fabric mills, cotton
2221	Broad woven fabric mills, silk and fibre
2231	Broad woven fabric mills, wool
2241	Narrow fabrics all kinds
2251	Women's full and knee length hose
2252	Hosiery, except women's full and knee length
2253	Knit outerwear mills
2254	Knit underwear mills
2257	Circular knit fabric mills
2258	Warp knit fabric mills
2259	Knitting mills, nec.
2261	Finishers broad woven cotton fabrics
2262	Finishers broad woven silks and man-made fibre
2269	Finishers of textiles, nec.
2271	Woven carpets and rugs
2272	Tufted carpets and rugs
2279	Carpets and rugs, nec.
2281	Yarn spinning mills, all fibres
2282	Yarn throwing, twisting, winding mills
2283	Yarn mills, wool, rugs and carpets
2284	Thread mills
2291	Felt goods, except woven and hats
2292	Lace goods

SIC	DESCRIPTION
2293	Paddings and upholstery filling
2294	Processed waste and recovered fibres
2295	Coated fabrics, not rubberized
2296	Tire cord and fabric
2297	Cordage and twine
2299	Textile goods, nec.
23	APPAREL
2311	Mens, youths and boys suits, overcoats
2321	Mens, youths and boys shirts ex. work
2322	Mens, youths and boys underwear
2323	Mens, youths and boys neckwear
2327	Mens, youths and boys trousers
2328	Mens, youths and boys work clothing
2329	Mens, youths and boys clothing, nec.
2331	Womens, misses and jrs. blouses, shirts
2335	Womens, misses and jrs. dresses
2337	Womens, misses and jrs. suits, coats, skirts
2339	Womens, misses and jrs. outerwear, nec.
2341	Womens, misses and jrs. infants underwear
2342	Brassieres and allied garments
2251	Millinery
2352	Hats and caps, except millinery
2361	Childrens and girls dresses, shirts
2363	Girls, childrens, coats and suits
2369	Girls, childrens, outerwear, nec.
2371	Fur goods
2381	Gloves, ex. knit and leather
2384	Robes and dressing gowns
2385	Raincoats and waterproof outer garments
2386	Leather and sheep lined clothing
2387	Apparel belts
2389	Apparel and accessories, nec.
2391	Curtains and draperies
2392	Housefurnishings, ex. curtains, drapes
2393	Textile bags
2394	Canvas and related products
2395	Pleating and stitching for the trade
2396	Auto trimmings, apparel findings etc.
2397	Schiffli machine embroideries
2399	Fabricated textile products, nec.
24	LUMBER AND WOOD PRODUCTS
2411	Logging camps and contractors
2421	Sawmills and planing mills, general
2426	Hardwood dimensions and flooring mills
2429	Special product sawmills, nec.

SIC	DESCRIPTION
2431	Millwork
2434	Wood kitchen cabinets
2435	Hardwood veneer and plywood
2436	Softwood veneer and plywood
2439	Structural wood members, nec.
2441	Nailed and lock corner wood boxes and shook
2448	Wood pallets and skids
2449	Wood containers, nec.
2451	Mobile homes
2452	Prefab wooden buildings and components
2491	Wood preserving
2492	Particleboard
2499	Wood products, nec.
25	FURNITURE AND FIXTURES
2511	Wood household furniture ex. upholstered
2512	Wood household furniture upholstered
2514	Metal household furniture
2515	Mattresses and bedsprings
2517	Wood T.V., radio, cabinets, etc.
2519	Household furniture, nec.
2521	Wood office furniture
2522	Metal office furniture
2531	Public building and furniture
2541	Wood, office and store fixtures
2542	Metal, office and store fixtures
2591	Drapery hardware blinds and shades
2599	Furniture and fixtures, nec.
26	PAPER PRODUCTS
2611	Pulp mills
2621	Paper mills, excluding building
2631	Paperboard mills
2641	Paper coating and glazing
2642	Envelopes
2643	Bags, except textile bags
2645	Die-cut paper and cardboard
2646	Pressed and molded pulp goods
2647	Sanitary paper products
2648	Stationery, tablets and rel. products
2649	Converted paper and paperboard products
2651	Folding paperboard boxes
2652	Set-up paperboard boxes
2653	Corrugated and solid fibre boxes
2654	Sanitary food containers
2655	Fibre cans, tubes, drums, etc.
2661	Building paper and building board mills

SIC	DESCRIPTION
27	PRINTING PUBLISHING
2711	Newspapers
2721	Periodicals
2731	Books
2732	Book printing
2741	Miscellaneous publishing
2751	Commercial printing, letterheads and screen
2752	Commercial printing, lithographic
2753	Engraving and plate printing
2754	Commercial printing, gravure
2761	Manifold business forms
2771	Greeting card publishing
2782	Blankbooks, looseleaf binders and devices
2789	Bookbinding and related work
2791	Typesetting
2793	Photoengraving
2794	Electrotyping and stereotyping
2795	Litho platemaking and related services
28	CHEMICALS
2812	Alkalies and chlorine
2813	Industrial gases
2816	Inorganic pigments
2819	Industrial inorganic chemicals, nec.
2821	Plastic materials, synthetic resins
2822	Synthetic rubber
2823	Cellulosic man-made fibres
2824	Synthetic organic fibres, ex. cellulosic
2831	Biological products
2833	Medicinal chemicals and botanical products
2834	Pharmaceutical preparations
2841	Soap and detergents, ex. special cleaners
2842	Spec. cleaners, polishing and sanitation preparations
2843	Surface active agents, sulfonated oils
2844	Perfumes, cosmetics, etc.
2851	Paints, varnishes, etc.
2861	Gum and wood chemicals
2865	Cyclic crudes, dyes and organic pigments
2869	Industrial organic chemicals, nec.
2873	Nitrogenous fertilizers
2874	Phosphatic fertilizers
2875	Fertilizers, mixing only
2879	Pesticides and agric. chemicals, nec.
2891	Adhesives and sealants
2892	Explosives
2893	Printing ink
2895	Carbon black
2899	Chem. and chem. preparations, nec.

SIC	DESCRIPTION
29	PETROLEUM
2911	Petroleum refining
2951	Paving mixtures and blocks
2952	Asphalt felts and coatings
2992	Lubricating oils and greases
2999	Petroleum and coal products, nec.
30	RUBBER AND PLASTICS
3011	Tires and inner tubes
3021	Rubber and plastics footwear
3031	Reclaimed rubber
3041	Rubber and plastics hose and belting
3069	Fabricated rubber products, nec.
3079	Miscellaneous plastics products
31	LEATHER PRODUCTS
3111	Leather tanning and finishing
3131	Boot and shoe cut stock findings
3142	House slippers
3143	Mens footwear, ex. athletic
3144	Womens footwear, ex. athletic
3149	Footwear, ex. rubber, nec.
3151	Leather gloves and mittens
3161	Luggage
3171	Womens handbags and purses
3172	Personal leather goods, ex. purses
3199	Leather goods, nec.
32	STONE, CLAY, GLASS AND CONCRETE PRODUCTS
3211	Flat glass
3221	Glass containers
3229	Pressed and blown glass, nec.
3231	Glass products made of purchased glass
3241	Cement, hydraulic
3251	Brick and structural clay tile
3253	Ceramic wall and floor tile
3255	Clay refractories
3259	Structural clay products, nec.
3261	Vitreous china plumbing fixtures, etc.
3262	Vitreous china kitchen articles
3263	Fine earthenware kitchen articles
3264	Porcelain electrical supplies
3269	Pottery products, nec.
3271	Concrete block and brick
3272	Concrete products ex. block and brick
3273	Ready-mixed concrete

SIC	DESCRIPTION
33	PRIMARY METAL INDUSTRIES
3312	Blast furnaces and rolling mills
3313	Electrometallurgical products
3315	Steel wire drawing and nail and spikes
3316	Cold rolled steel sheet, bars and strip
3317	Steel pipe and tubes
3321	Gray iron foundries
3322	Malleable iron foundries
3324	Steel investment foundries
3325	Steel foundries, nec.
3331	Primary smelting and refining of copper
3332	Primary smelting and refining of lead
3333	Primary smelting and refining of zinc
3334	Primary production of aluminum
3339	Prim. smelting and refining non ferrous metals, nec.
3341	Sec. smelting and refining non ferrous metals
3351	Rolling, drawing and extruding of copper
3353	Aluminum sheet, plat and foil
3354	Aluminum extruded products
3355	Aluminum rolling and drawing, nec.
3356	Roll, draw, extr. non ferrous metals except copper and aluminum
3357	Drawing and insulating of non ferrous wire
3361	Aluminum castings
3362	Brass, bronze and copper castings
3369	Non ferrous castings, nec.
3398	Metal heat treating
3399	Primary metal products, nec.

SIC	DESCRIPTION
34	FABRICATED METAL PRODUCTS
3411	Metal cans
3412	Metal shipping barrels, drums, kegs, etc.
3421	Cutlery
3423	Hand and edge tools, excluding saws and machine tools
3425	Hand saws and saw blades
3429	Hardware, nec.
3431	Enameled iron and metal sanitary ware
3432	Plumbing fixture fittings brass goods
3433	Heating equipment, except electric and warm air furnace
3441	Fabricated structural metal
3442	Metal doors, sash, frames, etc.
3443	Fabricated plate work-boilers
3444	Sheet metal work
3446	Architectural and ornamental metal work
3448	Prefabricated metal buildings and components
3449	Miscellaneous metal work
3451	Screw machine products
3452	Bolts, nuts, screws, rivets and washers
3462	Iron and steel forgings
3463	Non ferrous forgings
3465	Automotive stampings
3466	Crowns and closures
3469	Metal stampings, nec.
3471	Electroplating, polishing and coloring
3479	Coating, engraving and allied services, nec.
3482	Small arms ammunition
3483	Ammunition, except small arms, nec.
3484	Small arms
3489	Ordinance and accessories, nec.
3493	Steel springs, except wire
3494	Valves and pipe fittings, except plumbers brass goods
3495	Wire springs
3496	Miscellaneous fabricated wire products
3497	Metal foil and leaf
3498	Fabricated pipe and pipe fittings
3499	Fabricated metal products, nec.

SIC	DESCRIPTION
35	MACHINERY, EXCEPT ELECTRICAL
3511	Steam, gas, hydraulic turbines
3519	Internal combustion engines, nec
3523	Farm machinery and equipment
3524	Garden tractors and equipment
3531	Construction machinery and equipment
3532	Mining machinery and equipment, except oil
3533	Oil field machinery and equipment
3534	Elevators and moving stairways
3535	Conveyors and conveying equipment
3536	Hoists, industrial cranes, etc.
3537	Industrial trucks, tractors, etc.
3541	Machine tools, metal cutting types
3542	Machine tools, metal forming types
3544	Special dies and tools
3545	Machine tool accessories
3546	Power driven hand tools
3547	Rolling mill machinery and equipment
3549	Metalworking machinery, nec.
3551	Food products machinery
3552	Textile machinery
3553	Woodworking machinery

SIC	DESCRIPTION
3554	Paper industries machinery
3555	Printing trades machinery and equipment
3559	Special industry machinery, nec.
3561	Pumps and pumping equipment
3562	Ball and roller bearings
3563	Air and gas compressors
3564	Blowers and exhaust fans
3565	Industrial patterns
3566	Speed changers, drives and gears
3567	Industrial process furnaces
3568	Mechanical power trans. equipment, nec.
3569	General industrial machinery equipment, nec.
3572	Typewriters
3573	Electronic computing equipment
3574	Calc. and acct. machinery except computers
3576	Scales and balances, except laboratories
3579	Office machines, nec.
3581	Automatic merchandising machines
3582	Comml. laundry and dry cleaning machines
3585	Air conditioning and refrig. and warm air heating equipment
3586	Measuring and dispensing pumps
3589	Service industry machines, nec.
3592	Carburetors, pistons, valves
3599	Machinery, except electrical, nec.

36	ELECTRICAL AND ELECTRONIC MACHINERY
3612	Power, dist. and spec. transformers
3613	Switching and switchboard apparatus
3621	Motors and generators
3622	Industrial controls
3623	Welding apparatus, electric
3624	Carbon and graphite products
3629	Electrical indus. apparatus, nec.
3631	Household cooking equipment
3632	Household refrigerators and freezers
3633	Household laundry equipment
3634	Electric housewares and fans
3635	Household vacuum cleaners
3636	Sewing machines
3639	Household appliances, nec.
3641	Electric lamps
3643	Current-carrying wiring devices
3644	Noncurrent-carrying wiring devices
3645	Residential elect. lighting fixtures
3646	Comm. indust. electric lighting fixtures
3647	Vehicular lighting equipment
3648	Lighting equipment, nec.
3651	Radio and T.V. rec. sets, except commun.
3652	Phonograph records and pre recorded tapes
3661	Telephone and telegraph apparatus
3662	Radio and TV transmitting equipment, etc.
3671	Radio and TV tubes, except cathode
3672	Cathode ray picture tubes
3673	Transmit. indust. and spec. electron tubes
3674	Semiconductors and related devices
3675	Electronic capacitors
3676	Resistors, electronic applications
3677	Electronic coils, transformers, etc.
3678	Connectors, for electronic applications
3679	Electronic components, nec.
3691	Storage batteries
3692	Primary batteries, dry and wet
3693	Therapeutic X-Ray tubes, etc.
3694	Elec. equip. internal combustion engines
3699	Electric machinery, equip. supplies, nec.

37	TRANSPORTATION EQUIPMENT
3711	Motor vehicles and passenger car bodies
3713	Truck and bus bodies
3714	Motor vehicle parts and accessories
3715	Truck trailers
3721	Aircraft
3724	Aircraft engines and engine parts
3728	Aircraft parts and auxiliary equipment, nec.
3731	Ship building and repairing
3732	Boat building and repairing
3743	Railroad equipment
3751	Motorcycles, bicycles and parts
3761	Guided missiles and space vehicles
3792	Travel trailers and campers
3795	Tanks and tank components
3799	Transportation equipment, nec.

38	MEASURING, ANALYZING AND CONTROLLING INSTRUMENTS
3811	Scientific and research instr. and equipment
3822	Automatic temperature controls
3823	Indus. control instruments for measurement
3824	Totalizing fluid meters and count devices
3825	Electrical measuring testing equipment

SIC	DESCRIPTION
3829	Measuring and controlling devices, nec.
3832	Optical instruments and lenses
3841	Surgical and medical instruments
3842	Orthopedic and prosthetic appliances
3843	Dental equipment and supplies
3851	Ophthalmic goods
3861	Photographic equipment and supplies
3873	Watches, clocks, etc.
39	MISCELLANEOUS MANUFACTURING INDUSTRIES
3911	Jewelry, precious metal
3914	Silverware, plated ware, etc.
3915	Jewelers findings and materials
3931	Musical instruments
3942	Dolls
3944	Game, toys and childrens wgn. ex. dolls and bicycles
3949	Sporting and athletic goods, nec.
3951	Pens, mech. pencils, etc.
3952	Lead pencils, crayons, etc.
3953	Marking devices
3955	Carbon paper and inked ribbons
3961	Costume jewelry
3962	Feathers, artificial flowers
3963	Buttons
3964	Needles, pins, hooks, eyes and notions
3991	Brooms and brushes
3993	Signs and advertising displays
3995	Burial caskets
3996	Linoleum and other floorings, nec.
3999	Manufacturing industries, nec.
42	MOTOR FREIGHT TRANSPORTATION AND WAREHOUSING
4213	Trucking, except local
4214	Local trucking and storage
4221	Farm product warehousing and storage
4222	Refrigerated warehousing
4224	Household goods warehousing and storage
4225	General warehousing and storage
4226	Special warehousing and storage, nec.
4231	Maintenance facil. motor freight trans.

SIC	DESCRIPTION
45	TRANSPORTATION BY AIR
4511	Air transportation, certified carriers
4521	Air transportation, noncertified carriers
4582	Airports and flying fields
4583	Airport terminal services
49	ELECTRIC, GAS AND SANITARY SERVICES
4911	Electric services
4922	Natural gas transmission
4923	Natural gas transmission and distribution
4924	Natural gas distribution
4925	Mixed mfg or liquified petro gas production
4931	Electric and other services combined
4932	Gas and other services combined
4941	Water supply
4952	Sewerage systems
4953	Refuse systems
4959	Sanitary services, nec.
4961	Steam supply
4971	Irrigation systems
50	WHOLESALE TRADE - DURABLE GOODS
5012	Autos and other motor vehicles
5013	Auto parts and supplies
5014	Tires and tubes
5021	Furniture
5023	Home furnishings
5031	Lumber, plywood and millwork
5039	Construction materials, nec.
5041	Sporting and rec. goods and supplies
5042	Toys and hobby goods and supplies
5043	Photo equipment and supplies
5051	Metals service centres and offices
5052	Coal, minerals and ores
5063	Electrical equipment and supplies
5064	Electrical appliances, TV and radio
5065	Electronic parts and equipment
5072	Hardware
5074	Plumbing and heating equipment and supplies
5075	Warm air heating and air conditioning equipment
5078	Refrigeration equipment and supplies
5081	Commercial machines and equipment
5082	Construction and mining machinery and equipment

SIC	DESCRIPTION
5083	Farm and garden machinery and equipment
5084	Industrial machinery and equipment
5085	Industrial supplies
5086	Professional equipment and supplies
5087	Service estab. equipment and supplies
5088	Transportation equipment and supplies, except motor vehicles
5093	Scrap and waste materials
5094	Jewelry, watches, diamonds and other precious stones
5099	Durable goods, nec.
51	WHOLESALE TRADE - NONDURABLE GOODS
5111	Printing and writing paper
5112	Stationery supplies
5113	Industrial and personal service paper
5122	Drugs, drug proprietaries, etc.
5133	Piece goods woven fabrics
5134	Notions and other dry goods
5136	Mens and boys clothing and furnishings
5137	Womens, childrens clothing and accessories
5139	Footwear
5141	Groceries, general line
5142	Frozen foods
5143	Dairy products
5144	Poultry and poultry products
5145	Confectionery
5146	Fish and seafoods
5147	Meats and meat products
5148	Fresh fruits and vegetables
5149	Groceries and related products, nec.
5152	Cotton
5153	Grain
5154	Livestock
5159	Farm-product raw materials, nec.
5161	Chemicals and allied products
5171	Petroleum bulk stations and terminals
5172	Petrol and petrol products except bulk stat. and terminals
5181	Beer and ail
5182	Wines and distilled alcoholic beverages
5191	Farm supplies
5194	Tobacco and tobacco products
5198	Paints, varnishes and supplies
5199	Nondurable goods, nec.

SIC	DESCRIPTION
55	AUTO DEALERS AND GASOLINE STATIONS
5511	Motor vehicle dealers - new and used
5521	Motor vehicle dealers - used
5531	Auto and home supply stores
5541	Gasoline service stations
5551	Boat dealers
5561	Recreational and utility trailer dealers
5571	Motorcycle dealers
5599	Automotive dealers, nec.
58	EATING AND DRINKING PLACES
5812	Eating places
5813	Drinking places - alcoholic beverages
72	PERSONAL SERVICES
7211	Power laundries
7212	Garment pressing and agent for laundries
7213	Linen supply
7214	Diaper service
7215	Coin-operated laundries
7216	Dry cleaning, except rug
7217	Carpet and upholstery cleaning
7218	Industrial launderers
7219	Laundry and garment services, nec.
7221	Photo studios
7231	Beauty shops
7241	Barber shops
7251	Shoe repair shops
7261	Funeral service and crematories
7299	Miscellaneous personal services
73	BUSINESS SERVICES
7311	Advertising agencies
7312	Outdoor advertising services
7313	Radio, TV, publishers
7319	Advertising, nec.
7321	Consumer credt. reptg. agencies
7331	Direct mail advertising services
7332	Blueprinting and photocopying services
7333	Commercial photo, art, and graphics
7339	Steno and dup. services, nec.
7341	Window cleaning

SIC	DESCRIPTION
7342	Exterminating services
7349	Miscellaneous building services, nec.
7351	News syndicates
7361	Employment agencies
7362	Temporary help supply services
7369	Personnel supply services, nec.
7372	Computer prog. and software services
7374	Data processing services
7379	Computer related services, nec.
7391	Research and development labs.
7392	Management, consulting services
7393	Detective agencies
7394	Equipment rental services
7395	Photofinishing laboratories
7396	Trading stamp services
7397	Commercial testing laboratories
7399	Business services, nec.
75	AUTOMOTIVE REPAIR
7512	Car rental without drivers
7513	Truck rental without drivers
7519	Utility trailer and recreational vehicle rental
7523	Parking lots
7525	Parking structures
7531	Top and body repair shops
7534	Tire retreading and repair shops
7535	Paint shops
7538	General automotive repair shops
7539	Automotive repair shops, nec.
7542	Car washes
7549	Auto services, except repair and car washes

SIC	DESCRIPTION
76	MISCELLANEOUS
7622	Radio and television repair shops
7623	Refrigerator and air conditioning services and repairs
7629	Electrical repair shops, nec.
7631	Watch, clock and jewelry repair
7641	Reupholstery and furniture repair
7692	Welding repair
7694	Armature rewinding shops
7699	Repair shops, nec.
89	MISCELLANEOUS SERVICES
8911	Engineering and architectural services
8922	Noncommercial educ. sci and res.
8931	Accounting, audit and bookkeeping
8999	Services, nec.

APPENDIX E

PRODUCTIVITY DIFFERENTIALS - CANADA AND THE UNITED STATES

INTRODUCTION

Productivity is the measure of the efficiency of an economy in combining all resources (inputs) to produce the output. The resources used consist of all labour employed, capital, equipment, fuels and services. The output is the finished product.

Analyzing productivity and the changes in productivity from year to year is difficult. The problem lies in the need to have a constant unit of input to measure against the constant unit of output. To formulate all productive inputs into a quantifiable unit to measure against output is a very unwieldy process. Therefore, the accepted measurable input used in productivity analysis is the unit of labour, because regardless of the industry, labour is used in every production process and it can be measured in constant units.

Productivity analysis is not a highly refined science for several reasons. First, using only labour inputs as the measure against output ignores a number of important production factors. Second, there is very little hard data available which can be used and the data available is subject to error. Third, although a great deal of discussion takes place about "productivity", very little real research and analysis has been undertaken in this area. Rarely have productivity factors been used to translate economic or other data from one country to another, as we are doing here to translate U.S. waste generation per employee to Canadian levels. However, the methodology described below has been developed in consultation with several of Canada's leading productivity authorities and we are confident that the level of accuracy achieved is suitable for this project.

OBJECTIVE

The objective of this analysis is to provide a numerical comparison between the level of Canadian labour productivity and that of the U.S. This is

because we have estimates of U.S. waste generated by employee, by SIC and we have estimates of the number of Ontario employees by SIC. We wish therefore to apply a factor to the U.S. waste per employee estimates to account for productivity differentials between Canada and the U.S.

METHODOLOGY

We have approached this objective in the following manner.

1. An extensive literature search was undertaken to determine the trends of Canadian productivity for two time periods, namely: Post-War to 1969 and 1970-78. Although there are some gaps in the data available for the Post-War to 1969 period, work has been done by others in establishing patterns or trends.

2. After gathering all the available data on Canadian productivity, a comparison was made to American productivity data. We were extremely fortunate in meeting and discussing our work with Dr. Jim Frank of the Conference Board of Canada. Dr. Frank wrote the definitive work on Canada - U.S. productivity comparisons "Assessing Trends on Canada's Competitive Position: The Case of Canada and the United States" The Conference Board of Canada, 1977.

3. We reviewed the data in depth and developed a clear picture of Canadian productivity relative to American productivity.

4. Once this relationship was developed we felt it prudent to discuss our general approach and findings with other economists, particularly those working in the areas of data collection, sector analysis, forecasting and policy analysis. In all, we met or talked with over 30 people. These discussions indicated to us that our methodology and findings were realistic and viable.

PRODUCTIVITY IN CANADA - AN OVERVIEW

Canada's Post-War productivity trend is enviable. Except for a minor downward fluctuation in the early 1960's productivity in all sectors increased at a constant rate. Moreover, the output resulting from this productivity met with a fairly constant consumer demand. For an industrialized nation, Canada faired very well in comparison with her major trading partners.

However, during the 1970's, particularly the latter half, Canada's overall productivity trend declined substantially. There seems to be two major factors contributing to this. First, there was a clear decline of productivity in Canada's oil and natural gas related industries and second, there was a marked slowdown in the growth rate of the capital intensity of production in most industrial sectors. This cause is one for concern as our analysis shows that Canada is more highly productive in relation to the U.S. in those industrial sectors that are capital intensive. Canada has been roughly 75% as productive as the U.S. in labour intensive industries.

Canada'a productivity trend is outlined in Table I. The table clearly shows a declining rate of productivity after 1972.

TABLE I

ANNUAL % CHANGES OF LABOUR PRODUCTIVITY

Year	Output %
1970-71	5.8
1971-72	7.2
1972-73	9.0
1973-74	3.3
1974-75	-5.5
1975-76	5.3
1976-77	3.8

Source: Statistics Canada "Aggregate Productivity Measures 1946-77". catalogue number 14-201 (Annual).

From 1976-1979, productivity in Canada rose, but at a much slower rate than the average gain of the Post-War period up to the early 1970's. Hard data is not available on this increase but discussions with Statistics Canada officials indicate a general 2% increase in productivity for these years. Moreover, indications are that this trend of small increases will continue.

Table II gives an overview of industrial productivity over the period 1972-1979 using 1975 as a base year. It is apparent from these numbers that productivity in most industries has experienced a minor turnaround since 1976.

TABLE II

INDEX NUMBER OF INDUSTRIAL PRODUCTIVITY 1975=100

Industry	1972	1973	1974	1975	1976	1977	1978	1979
General	94	103	106	100	106	109	115	120
Mining	100	111	110	100	103	106	98	106
Mfg.	94	103	107	100	106	109	117	121
El. Gas & Wat	85	92	100	100	109	116	122	130
Const.	88	92	96	100	105	104	103	105

Source: Monthly Bulletin of Statistics. United Nations Department of International Economic and Social Affairs, June 1980.

THE CANADA - UNITED STATES RELATIONSHIP

In most discussions of how Canada is fairing, a comparison is made to the U.S. This is also the case with productivity analysis.

Unfortunately, very little analysis has been undertaken in comparing Canada-U.S. productivity levels at the industry level. The major work in this area was undertaken by Dr. Frank of the Conference Board of Canada. For the

purposes of this study, Dr. Frank has given verbal approval to use the data in his book "Assessing Trends on Canada's Competitive Position: The Case of Canada and the United States" (The Conference Board of Canada, 1977). Additionally, we spoke with Mr. Harvey Sims of the Department of Finance, Government of Canada; Mr. Sims co-authored an analytic paper in 1980 entitled "Recent Changes in Patterns of Productivity Growth in Canada".

From discussions with Dr. Frank, Mr. Sims and others we were able to ascertain that in the 1960's, Canada's durable goods industries were found to be 73% as productive as their U.S. counterparts when compared using Canadian prices. By the late 1960's and early 1970's this percentage had risen to almost 90%. These figures indicate that the durable goods industries have experienced an excellent improvement in relative labour productivity over the decade. These improvements were made larely in the metal products and motor vehicles and parts industries.

TABLE III

CANADIAN FACTORY PRODUCTIVITY RELATIVE TO THE U.S. PRODUCTIVITY

Year	Canadian Productivity
1968	.85
1969	.86
1970	.90
1971	.92
1972	.91
1973	.91

Source: Relative Productivity Levels, 1947-1973, An International Comparison, European Economic Review 16 (1981).

The 33 manufacturing industries studied by Dr. Frank were found to have increased their productivity by some 15% from 1967-74. From this he concluded that Canadian industries were approximately 90% as productive as their U.S. counterparts. These finding were consistent with other research relating to a general overview of Canadian productivity. Moreover there seems to be some evidence that this increase trend will continue into the future. While it is unlikely that Canadian productivity will achieve par with the U.S., the productivity gap will close marginally over the medium term. One of the major reasons for this apparent trend vis a vis U.S. productivity is that Canadian industries are by and large more capital intensive than American industries. As was noted before, capital intensive industries in Canada have performed relatively better than labour intensive industries.

Table IV outlines the estimated productivity levels from 1967-1974 by major industry groups using Canadian prices.

TABLE IV

CANADIAN PRODUCTIVITY AS A PERCENT OF U.S.PRODUCTIVITY

	1967 (%) US=100%	1974 (%)
Non Durable		
Food Processing	72	69
Textiles, Clothing, Knitting	70	83
Paper Products	76	77
Petroleum Refining	37	70
Miscellaneous	44	53
Durable		
Wood Products	111	117
Metal Products	70	83
Motor Vehicles and Parts	77	100
Miscellaneous	60	68

Source: The Conference Board of Canada: "Assessing Trends in Canada's Competitive Position."

Table V outlines the relative productivity levels (in Canadian prices) between Canada and the U.S. for 33 manufacturing industries in 1972. These are the most recent data available on a disaggregated industry basis. These data will therefore be used in the waste generation model to account for productivity differentials. Because these figures are somewhat dated, a sensitivity analysis will be undertaken to evaluate the effects of possible productivity changes since 1972 on waste generation model output.

TABLE V

CANADIAN PRODUCTIVITY AS A PERCENT OF U.S. PRODUCTIVITY, 1972

Industry	%
Non-Durable	
Food - Slaughtering and Meat Processing	80
Dairy Products	60
Fish Products	75
Fruit and Vegetable Processing	92
Biscuit Manufacturing	51
Baked Products	76
Soft Drinks	93
Breweries	69
Confectionery	59
Textiles	
- Cotton Yarn and Clothing Mills	68
Woolen Textile Mills	116
Synthetic Textile Mills	72
Hosiery Mills	92
Other Knitting Mills	83
Men's Clothing	93
Paper Products	
- Pulp and Paper Mills	79
Paper Bag and Box	66
Other Paper Converters	62
Petroleum Products	
- Petroleum Refining	60
Miscellaneous	
- Paint and Varnish Mfg.	50
Soaps and Cleaners	62
Tobacco Products	57

TABLE V (Cont'd)

Industry	%
Durable	
Wood Products	
- Sawmills, Sash and Doors	122
Veneer and Plywood Mills	93
Household Furniture	76
Metal Products	
- Iron and Steel Mills	112
Iron Foundries	87
Non-Ferrous Metal Smelting	76
Fabricated Structural Metals	63
Motor Vehicles	
- Motor Vehicle Parts and Accessories	89
Truck and Bus Bodies	53
Miscellaneous	
- Heating and Air Conditioning	56
Major Appliance Mfg.	61

Source: The Conference Board of Canada "Assessing Trends in Canada's Competitive Position."

CONCLUSIONS

Our reasearch has indicated a significant lack of data available on Canada-U.S. productivity differentials on a disaggregated industry basis. This problem is complicated by the lack of productivity analysis done as a problem solving process, such as we are undertaking. However, our approach to this task and our conclusions have been supported by leading authorities in this field.

The research undertaken has led us to conclude that Canada's aggregate productivity is presently 85-95% that of the U.S. and rising at roughly 2% per year. Although Canadian productivity is unlikely to reach par with the U.S., the gap is being closed marginally. Therefore, based on an extensive literature search, analysis of data, and discussions with

recognized authorities we have decided to use the data prepared by Dr. J. Frank of the Conference Board of Canada (presented above as Table V) as our waste generator model to account for productivity differentials between Canada and the U.S.

BIBLIOGRAPHY (Partial List)

Boner, B. and Neef, A. : "Productivity and Unit Labour Cost in 12 Industrial Countries". U.S. Monthly Labour Review July 1977, Washington, U.S.A.

Christensen, L.; Cummings, D.; Jorgensen, D. : "Relative Productivity Levels, 1947-1973 An International Comparison". European Economic Review, 1981. North Holland Publishing Company.

Frank, Dr. J. : "Assessing Trends in Canada's Competitive Positic The Case of Canada and the United States". Conference Board of Canada, Ottawa, 1977.

Sims, H. and Stanton, J. : "Recent Changes in Patterns of Productivity Growth in Canada". Department of Finance, Ottawa, 1980.

Monthly Bulletin of Statistics : United Nations Department of International, Economic and Social Affairs, New York, June 1980.

Aggregate Productivity Measures 1946-1977 : Statistics Canada catalogue number 14-201, Ottawa October 1978.

Aggregate Productivity Measures 1979 : Statistics Canada catalogue number 14-201, Ottawa October 1980.

Manufacturing Industries of Canada National and Provincial Areas 1978 : Statistics Canada catalogue number 31-203, Ottawa 1980.

CONTACTS (Partial List)

N. Hartgerink	-	Statistics Canada - Manufacturing and Primary Industry Division, Ottawa
H. Sims	-	Department of Finance - Social Policy Branch, Ottawa
I. MacLain	-	Department of Industry Trade and Commerce - Petroleum and Industrial Chemicals Branch, Ottawa
D. Prodrusni	-	Department of Industry Trade and Commerce - Chemicals Branch Sector Analysis, Ottawa
M. Levebve	-	Statistics Canada - Energy and Minerals Sector, Ottawa
J. Frank	-	Conference Board of Canada, Ottawa
M. Issa	-	Statistics Canada - Industry and Commodity Statistics, Ottawa
P. Devine	-	Department of Finance, International Trade and Finance Branch, Ottawa
Economic Council of Canada	-	Technological Change, Productivity and Growth Division, Ottawa

APPENDIX F

SUMMARY OF LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE

ENDI

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUGUST 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
INCINERATION:					
TRICIL	Corunna	Incinerator (Horizontal Chamber Unit)/ 200 litres per minute	• Acids • Alkalis • Metal Finishing Wastes • Cyanides • Chemical Fertilizer Waste • Phosphates • Other Inorganic • Oily Water • Waste Oils • Organic Solvents • Chlorinated Solvents • Plastic Resins • Amines • Glycols • Phenols • Other Organic • Pigments, Paints, Printing and Adhesives • Pesticides • Detergents, Cleaners & Soaps • Pharmaceutical & Cosmetics • Plant and Animal Wastes • Inert Sludges	14,302,702 (15,610,496)	• Other activities include: - on-site landfill - receiving tankage - solids separation (screening and clarification) - pH adjustment • $5 million plant modification plan approved in February/82 - new incinerator and stack construction - air pollution control and plant monitoring • Incineration capacity will increase to 260 litres per minute
SYNTATH	St. Catharines	Incinerator	• Organic solvents • Other organic • Pharmaceutical and Cosmetics • Plant and Animal wastes	15,012 (17,295)	• On-site storage of solvents for resale recently approved by M.O.E. • Activities also include transfer and spill cleanup
TOTAL INCINERATION				14,317,714 (15,627,791)	
LANDFILL:					
ARMPRIOR	Township of McNab	Landfill	• Other Inorganic • Oily Water	121,306 (142,886)	

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981, and April 1st, 1981 to March 31st, 1982.

Note: Numbers in Brackets are for August 1980 to July 1981

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUGUST 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
TOWNSHIP OF HAMILTON	Township of Hamilton	Landfill	• Plastic Resins	380,600 (422,700)	
CITY OF PARIS	Paris	Landfill	• Oily Water • Plant and Animal Wastes • Inert Sludges	163,000 (117,400)	
CITY OF BRANTFORD	Brantford	Landfill	• Pigments, Paints, Printing and Adhesives • Detergents, Cleaners & Soaps • Plant and Animal Wastes • Inert Sludges	1,193,310 (1,246,583)	
CITY OF GUELPH	Guelph	Landfill	• Phosphates • Other Inorganic • Other organic • Pigments, Paints, Printing and Adhesives • Inert Sludges	870,475 (846,400)	
CITY OF WELLAND	Welland	Landfill	• Inert Sludges	348,800 (405,900)	
CITY OF BARRIE	Barrie	Landfill	• Oily Water • Pigments, Paints, Printing and Adhesives • Pharmaceutical and Cosmetics	33,630 (34,305)	
INCOL	Corunna	Landfill	• Acids • Alkalis • Metal Finishing Wastes • Cyanides • Phosphates • Other Inorganic • Oily Water • Waste Oils • Organic Solvents • Amines • Glycols • Phenols • Other Organic • Pigments, Paints Printing and Adhesives • Pesticides • Detergents • Plastic Resins	5,899,993 (6,259,469)	

[1] Source:
Ministry of the Environment Waybill Records August 1st, 1980 to July 31st, 1981 and April 1, 1981 to March 31st, 1982.

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUGUST 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
RIDGE LANDFILL	Township of Harwich	Landfill	• Acids • Phosphates • Alkalis • Oily Water • Metal Finishing Wastes • Other Inorganic • Waste Oils • Organic Solvents • Chlorinated Solvents • Plastic Resins • Other Organic • Pigments, Paints, Printing and Adhesives • Detergents, Cleaners and Soaps • Pharmaceuticals and Cosmetics • Plant and Animal Wastes • Inert Sludges	949,588 (1,876,992)	This site no longer receives liquid industrial waste
TOWNSHIP OF MARIPOSA	Township of Mariposa	Landfill	• Inert Sludges	195,000 (132,000)	This site no longer receives liquid industrial waste
REGIONAL MUNICIPALITY OF HALTON	Oakville	Landfill	• Inert Sludges	(23,676)	This site no longer receives liquid industrial waste
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH	Hamilton	Landfill	• Inert Sludges	(13,200)	This site no longer receives liquid industrial waste
ERIC PAUZE CONSTRUCTION	Township of Tiny	Landfill	• Metal Finishing Wastes • Oily Water • Organic Solvents • Chlorinated Solvents • Pigments, Paints, Printing and Adhesives • Plant and Animal Wastes • Inert Sludges	(82,615)	This site no longer receives liquid industrial waste
KOMLO LANDFILL SITE	Stratford	Landfill	• Inert Sludges		This site no longer receives liquid industrial waste
TOTAL LANDFILLS				10,155,702 (11,621,576)	

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUGUST 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
PRIVATE LANDFILLS AND SLUDGE FARMS:					
SHELL CANADA	Oakville	Sludge Farm	• Waste Oils	(2,642)	No Waybill activity between April 1, 1981 and March 31/82
JOHNS MANVILLE	Scarborough	Sludge Farm		(3,600)	See above
IMPERIAL OIL	Sarnia	Sludge Farm	• Oily Water • Inert Sludges • Waste Oils • Other Organic	2,467,188 (3,151,810)	
DOW CHEMICAL	Sarnia	Private Landfill	• Alkalis • Plastic Resins • Plant and Animal Wastes • Inert Sludges • Glycols • Other Organic	2,768,630 (2,592,588)	
ABITIBI PROVINCIAL	Halton Hills	Private Landfill	• Chlorinated Solvents • Plastic Resins • Other Organic • Pigments, Paints, Printing and Adhesives	578,700 (633,900)	
BRITISH PETROLEUM REFINERY	Oakville	Sludge Farm	• Oily Wastes • Other Organic	(219,500)	No Waybill activity between April 1, 1981 and March 31/82
TOTAL PRIVATE LANDFILLS AND SLUDGE FARMS				5,814,518 (6,604,040)	

[1] Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 AUGUST 1/80 TO JULY 31/81 (IMPERIAL GALLONS)	COMMENTS
WATER POLLUTION CONTROL PLANTS:					
PORT DALHOUSIE	St. Catharines	Water Pollution Control Plant	• Plant and Animal Wastes	9,600 (6,400)	
WESTERLY PLANT	Windsor		• Other Inorganic • Other Organic	(112,000)	No Waybill activity between April 1, 1981 and March 31, 1982
LITTLE RIVER PLANT	Windsor	Water Pollution Control Plant		(4,000)	See above
HIGHLAND CREEK	Toronto	Water Pollution Control Plant	• Acids	(5,000)	See above
NORTH DON	Toronto	Water Pollution Control Plant	• Pigments, Paints, Printing and Adhesives • Plant and Animal Wastes	4,000 (13,525)	
ASHBRIDGES BAY	Toronto	Water Pollution Control Plant	• Acids • Waste Oils • Other Organic • Plant and Animal Wastes • Other Inorganic • Oily Water	36,900 (433,655)	
HOLLAND LANDING	Newmarket	Lagoon	• Phosphates	160,880 (166,000	
BAKER ROAD	Grimsby	Water Pollution Control Plant	• Other Organic • Plant and Animal Wastes • Phosphates • Other Inorganic	1,139,600 (129,000)	
CLARKSON	Mississauga	Water Pollution Control Plant	• Alkalis • Other Inorganic • Oily Water • Detergents, Cleaners and Soaps • Plant and Animal Wastes • Other Organic	697,827 (524,987)	
BARRY'S BAY	Barry's Bay	Water Pollution Control Plant	• Alkalis	6,776 (10,326)	

1. Source:
Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUGUST 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
HAMILTON	Hamilton	Water Pollution Control Plant	• Other Organic • Detergents, cleaners and Soaps	241,500 (18,000)	
BELLEVILLE	Belleville	Water Pollution Control Plant	• Other Inorganic • Oily Water • Organic Solvents • Other Organic • Detergents, cleaners and Soaps • Plant and animal wastes	202,800 (167,200)	
MIDLAND	Midland	Water Pollution Control Plant	• Inert Sludges	4,000 (10,000)	
HUMBER PLANT	Etobicoke	Water Pollution Control Plant	• Other Inorganic	7,000 (7,000)	
NIAGARA FALLS	Niagara Falls	Water Pollution Control Plant	• Plant and Animal Wastes	8,000 (5,600)	
DUFFIN CREEK	Pickering	Water Pollution Control Plant	• Inert Sludges	3,050	
HARMONY CREEK	Whitby	Water Pollution Control Plant	• Inert Sludges	2,350	
PETERBOROUGH	Peterborough	Water Pollution Control Plant	• Inert Sludges	9,800	
KITCHENER	Kitchener	Water Pollution Control Plant	• Inert Sludges	138,932	
GANANOQUE	Gananoque	Lagoon	• Inert Sludges	13,800	
B.P. REFINERY	Oakville	Water Pollution Control Plant	• Oily Water	53,100	
FALCONBRIDGE NICKEL	Sudbury	Water Pollution Control Plant	• Oily Water	2,500	

Source: Ministry of the Environment Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED - APRIL 1/81 TO MARCH 31, 1982 (AUG. 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
DuPONT OF CANADA	Maitland	Water Pollution Control Plant	• Oily Water	6,000	
CHRYSLER CANADA	Windsor	Water Pollution Control Plant	• Oily Water	6,000	
TOTAL WATER POLLUTION CONTROL PLANTS				2,754,415 (1,612,693)	
RECLAIMERS/REUSERS					
ANACHEMIA SOLVENTS	Mississauga	Reclaimer	• Organic Solvents • Chlorinated Solvents • Other Organic	52,245 (88,700)	
THOMAS WASTE REMOVAL	Mississauga	Reuser	• Other Inorganic • Oily Water • Other Organic	(25,530)	No Waybill activity between April 1, 1982 and March 31st, 1982
TEXACO	Mississauga	Reuser	• Oily Water	(7,500)	See above
GULF OIL	Mississauga	Reuser	• Other Inorganic	(3,000)	See Above
THOMSCAN INDUSTRIAL SERVICES	Mississauga	Reuser	• Oily Water	291,966 (78,010)	
INDUSTRIAL CHEMICAL	Toronto	Reclaimer	• Chlorinated Solvents	1,700 (15,519)	
CANAM OIL	Toronto	Re-refiner	• Oily Water • Waste Oils • Organic Solvents	619,645 (32,630)	
AIMCO SOLREC	Toronto	Reclaimer	• Organic Solvents	16,450 (31,025)	
SURPASS CHEMICAL	Toronto	Reclaimer	• Acids	(37,600)	No Waybill activity between April 1, 1981 and March 31, 1982
MINERAL RECOVERY	Toronto	Reclaimer	• Other Organic	(86,408)	No Waybill Activity between April 1, 1981 and March 31, 1982

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE I-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (Aug. 1/80 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
BRITISH PETROLEUM REFINERY	Oakville	Reclaimer	• Oily Water	151,200 (219,950)	
FORD MOTOR COMPANY	Oakville	Reclaimer	• Oily Water	(34,200)	No Waybill activity between April 1, 1981 and March 31, 1982
FORD MOTOR COMPANY	Windsor	Reclaimer	• Oily Water	(8,200)	See Above
MOTOR CITY PETROLEUM	Windsor	Reclaimer	• Oily Water • Waste Oils • Organic Solvents	141,490 (75,930)	
GORMLEY SAND AND GRAVEL	Gormley	Reuser	• Oily Water • Waste Oils • Chlorinated Solvents	275,486 (274,831)	• Oils used mainly for dust control - road application
CEDARHURST QUARRIES	Mount Albert	Reuser	• Oily Water • Plant and Animal Wastes	2,700 (2,700)	
CANAN OIL	Breslau	Re-refiner Reclaimer	• Other Inorganic • Oily Water • Waste Oils • Organic Solvents • Chlorinated Solvents • Pigments, Paints, Printing and Adhesives • Plant and Animal Wastes	618,954 (1,639,485)	
BRESTEEL	Breslau	Reclaimer Re-refiner	• Acids • Alkalis • Metal Finishing Wastes • Oily Water • Waste Oils	664,248 (648,635)	
RIO ALGOM	Elliott Lake	Reuser	• Acids	320,000 (285,000)	Used in mineral recovery
STELCO	Hamilton	Reuser	• Acids	15,764 (22,353)	

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981 and April 1st, 1981 to March 31st, 1982.

TABLE F-1

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE IN ONTARIO[1]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUG.1/81 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
SCANDLX	Kitchener	Reclaimer	• Acids • Alkalis • Metal Finishing Wastes • Phosphates • Other Inorganic • Oily Water • Waste Oils • Organic Solvents • Chlorinated Solvents	3,531,971 (2,395,864)	
VARNI COLOUR	Elmira	Reclaimer	• Metal Finishing Wastes • Organic Solvents • Chlorinated Solvents	32,753 (15,520)	
WOODINGTON SYSTEMS	Thorold	Reuser	• Oily Water • Waste Oils	187.253 (412,330)	
AGNEW LAKE MINES	Espanola	Reuser	• Acids • Oily Water	468,000 (468,000)	Used in mineral recovery
CANTOW SERVICES	Sarnia	Reclaimer	• Oily Water • Waste Oils	200	
ENTROPLX CORP.	Sarnia	Reclaimer	• Oily Water • Waste Oils	39,639	
RETEK RESOURCE RECOVERY	Brantford	Reclaimer		245,290	
TOTAL RECLAIMERS/REUSERS				7,684,414 (6,908,720)	

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981, and April 1st, 1981 to March 31st, 1982.

TABLE F-2

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE OUTSIDE ONTARIO [1].

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31/82 (AUG.1/81 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
TRICIL	Mercier, Quebec	Incinerator, Landfill	• Organic Solvents • Pigments, Paints, Printing and Adhesives	83,675 (110,806)	
SERVICE CENTRAL DE RESERVOIRS	Montreal Quebec	Reclaimers	• Organic Solvents • Pigments, Paints, Printing and Adhesives	35,534 (53,260)	
KINETIC CONTAMINANTS	Niska, Alberta	Storage	• PCB's	5,295 (1,750)	
SCA	Model City New York	Physical Chemical Treatment	• Acids • Organic Solvents	83,088 (4,000)	
NORTEL	Cohoes New York	Reuser	• Organic Solvents • Other Organic	346,700 (16,300)	Burn solvents
FRONTIER CHEMICAL	Niagara Falls New York	Physical Chemical Treatment	• Acids, • Oily Water • Alkalis • Water Oils • Metal Finishing Wastes • Cyanides • Organic Solvents • Phosphates • Chlorinated • Other Inorganic Solvents • Other Organic • Pigments, Paints, Printing and Adhesives • Pesticides • Detergents, Cleaners and Soaps • Inert Sludges	2,348,121 (3,311,372)	
FRONTIER NAL	Niagara Falls New York	Transfer Station	• Acids • Waste Oils • Cyanides • Other Inorganic • Pigments, Paints, Printing and adhesives	84,793 (516,495)	

1. Source: Ministry of the Environment Waybill Records August 1st, 1980 to July 31st, 1981, and April 1st, 1981 to March 31st, 1982.

TABLE F-2

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE OUTSIDE ONTARIO [1.]

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31.82 (AUG.1/81 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
CECOS	Niagara Falls New York	Landfill, Physical Chemical Treatment	• Acids • Pigments, Paints, Printing, and Adhesives	17,815 (10,160)	
TONAWANDA TANK TRANSPORT	Buffalo New York			270	
INDUSTRIAL ENVIRONMENTAL SERVICES	Mount Marion New York			16,500	
LIQUID DISPOSAL	Utica Michigan	Incinerator	• Acids • Oily Water • Pigments, Paints, Printing and Adhesives	17,400 (77,700)	
GENERAL OIL	Redford Michigan	Reclaimer	• Waste Oils	25,600 (28,566)	
ENCO CHEMICAL	Detroit Michigan	Reclaimer	• Waste Oils	(2,500)	• No Waybill activity between April 1/81 and March 31/82
CHEM-MET SERVICES	Wyandotte Michigan	Physical Chemical Treatment	• Acids • Alkalis • Other Inorganic • Other Organic • Pigments, Paints, Printing and Adhesives	775,255 (345,242)	
NELSON INDUSTRIAL	Detroit Michigan	Physical Chemical Treatment	• Acids • Alkalis • Metal Finishing Wastes • Oily Water • Detergents, Cleaners & Soaps	399,696 (62,805)	
CARTER'S WASTE OIL	Detroit Michigan	Reclaimer	• Oily Water • Waste Oils	386,150 (195,450)	
ENVIRONMENTAL WASTE CONTROL	Inkster Michigan	Reclaimer	• Organic Solvents • Chlorinated Solvents	25,000	
LENARDS OIL	Detroit Michigan	Reclaimer	• Oily Water • Waste Oil	206,949	
CANAN OIL	Fremont Ohio	Reclaimer	• Other Inorganic	(18,109)	Now Chemical Waste Management

1. Source: Ministry of the Environment Waybill Records August 1st, 1980 to July 31st, 1981, and April 1st, 1981 to March 31st, 1982.

TABLE F-2

LICENSED RECEIVERS OF LIQUID INDUSTRIAL WASTE OUTSIDE ONTARIO[1].

NAME	LOCATION	FACILITY TYPE/CAPACITY	TYPE OF WASTE RECEIVED MINISTRY OF THE ENVIRONMENT WASTE CLASSIFICATION	QUANTITY OF WASTE RECEIVED APRIL 1/81 TO MAR. 31.82 (AUG.1/81 TO JULY 31/81) (IMPERIAL GALLONS)	COMMENTS
ERIE POLLUTION CONTROL	Bedford Ohio	Physical/Chemical	• Acids	(74,800)	• No Waybill activity between April 1/81 and March 31/82
CHEMICAL WASTE MANAGEMENT	Vickery Ohio	Reclaimer	• Oily Water • Waste Oils	82,000	Formerly Canam Oil
WISEMAN OIL	Coraopolis Pennsylvania	Reclaimer	• Acids • Waste Oils • Organic Solvents	270,740 (82,780)	
C&M CHEMICAL	Pittsburgh Pennsylvania	Reclaimer	• Waste Oils • Organic Solvents	22,200	
TOTAL OUT OF PROVINCE RECEIVERS				5,232,281 (4,912,095)	

1. Source: Ministry of the Environment - Waybill Records August 1st, 1980 to July 31st, 1981, and April 1st, 1981 to March 31st, 1982.

APPENDIX G

GROUPINGS OF TOWNS AND CITIES

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
AURORA	AURORA
	BALLANTRAE
	BOLTON
	BUTTONVILLE
	CONCORD
	GOODWOOD
	GORMLEY
	HOLLAND LDG
	KETTLEBY
	KING
	KLEINBURG
	MAPLE
	NEWMARKET
	NOBLETON
	OAK RIDGES
	SCHOMBERG
	STOUFFVILLE
	UXBRIDGE
	VANDORF
TORONTO	AGINCOURT
	DON MILLS
	DOWNSVIEW
	ETOBICOKE
	ISLINGTON
	MARKHAM
	MILLIKEN
	REXDALE
	RICHMOND HILL
	SCARBOROUGH
	THORNHILL
	TORONTO
	UNIONVILLE
	WEST HILL
	WESTON
	WILLOWDALE
	WOODBRIDGE

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
SARNIA	ALVINSTON
	ARKONA
	BRIGDEN
	CORUNNA
	COURTRIGHT
	FLORENCE
	FOREST
	GRAND BEND
	OIL CITY
	OIL SPRINGS
	PETROLIA
	POINT EDWARD
	SARNIA
	SOMBRA
	THEDFORD
	WATFORD
	WYOMING
MISSISSAUGA	MISSISSAUGA
OAKVILLE	OAKVILLE
OTTAWA	ALMONTE
	BOURGET
	CARLETON PL
	CARLSBAD SP
	CARP
	CASSELMAN
	CUMBERLAND
	DUNROBIN
	EMBRUN
	KANATA
	KARS
	KEMPTVILLE
	LANARK

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTTAWA	(CONT)	LEITRIM
		MANOTICK
		NORTH GOWER
		ORLEANS
		OTTAWA
		PAKENHAM
		PERTH
		ROCKLAND
		SMITHS FALLS
		ST ALBERT
		STITTSVILLE
KINGSTON		AMHERST VIEW
		BARRIEFIELD
		BATTERSEA
		CARRYING PL
		ELGINBURG
		GLENBURNIE
		HARROWSMITH
		KINGSTON
		MILLHAVEN
		ODESSA
		PORTLAND
		SYDENHAM
		WESTBROOKE
		WOLFE ISLAND
WINDSOR		AMHERSTBURG
		BELLE RIVER
		COMBER
		COTTAM
		EMERYVILLE
		ESSEX
		HARROW
		KINGSVILLE
		LEAMINGTON
		MAIDSTONE
		OLDCASTLE

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
WINDSOR	(CONT)	RUSCOM STN
		RUTHVEN
		STONEY POINT
		TECUMSEH
		WINDSOR
CORNWALL		ADDISON
		ALEXANDRIA
		APPLE HILL
		BAINSVILLE
		BERWICK
		CARDINAL
		CHESTERVL-DUN
		CORNWALL
		CRYSLER
		FINCH
		INGLESIDE
		IROQUOIS
		LANCASTER
		LONG SAULT
		MARTINTOWN
		MAXVILLE
		MOOSE CREEK
		MORRISBURG
		N LANCASTER
		NEWINGTON
		S LANCASTER
		WILLIAMSBURG
		WILLIAMSTOWN
		WINCHESTER
HALTON HILLS		ACTON
		CAMPBELLVILLE
		HALTON HILLS
		HEPWORTH
		HORNBY
		LIMEHOUSE
		MILTON

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
HALTON HILLS	(CONT)	MOFFAT
		ROCKWOOD
HAMILTON		ANCASTER
		BINBROOK
		BURLINGTON
		CALEDONIA
		CARLISLE
		DUNDAS
		FRUITLAND
		GREENSVILLE
		HAMILTON
		MILLGROVE
		MOUNT HOPE
		STONEY CREEK
		VINEMOUNT
		WATERDOWN
BELLEVILLE		BANCROFT
		BATAWA
		BELLEVILLE
		BLOOMFIELD
		BRIGHTON
		CAMPBELLFORD
		CORBYVILLE
		DEMORESTVILLE
		DESERONTO
		FOXBORO
		FRANKFORD
		HASTINGS
		MADOC
		MARMORA
		MERRICKVILLE
		MILFORD
		PLAINFIELD
		ROSLIN
		SHANNONVILLE
		STIRLING

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
BELLEVILLE	(CONT)	TRENTON
		TWEED
		WARKWORTH
HAWKESBURY		HAWKESBURY
		L ORIGNAL
		PLANTAGENET
		RUSSELL
		S ANNE PRES
		S ISDR PRES
		VANKLEEK HILL
BARRIE		ALLISTON
		BALA
		BALDWIN
		BARRIE
		BEAVERTON
		BEETON
		BRADFORD
		CHURCHILL
		COLDWATER
		COLLINGWOOD
		COOKSTOWN
		CREEMORE
		ELMVALE
		GILFORD
		HAWKESTONE
		HILLSDALE
		KESWICK
		MIDLAND
		MINESING
		MOUNT ALBERT
		NEW LOWELL
		ORILLIA
		ORO STATION
		PEFFERLAW
		QUEENSVILLE
		STAYNER

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
BARRIE	(CONT)	SUNDERLAND
		SUTTON WEST
		THORNTON
		VIC-HARBOUR
WELLAND		CAISTOR CTR
		CAYUGA
		CRYSTAL BEACH
		FENWICK
		FONTHILL
		FORT ERIE
		PORT COLBORNE
		PORT ROBINSON
		RIDGEWAY
		STEVENSVILLE
		WAINFLEET
		WELLAND
CHATHAM		AUBURN
		BLENHEIM
		BOTHWELL
		CHARING CROSS
		CHATHAM
		DRESDEN
		ERIEAU
		HIGHGATE
		PORT LAMBTON
		RIDGETOWN
		THAMESVILLE
		TILBURY
		WALLACEBURG
		WHEATLEY
KITCHENER		AYR
		BADEN
		BATH
		BLOOMINGDALE

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
KITCHENER	(CONT)	BRANCHTON
		BRESLAU
		BRIGHT
		CAMBRIDGE
		CONESTOGO
		DRUMBO
		ELMIRA
		FLORADALE
		FREELTON
		HAWKESVILLE
		HEIDELBERG
		INNERKIP
		KILBRIDE
		KITCHENER
		LINWOOD
		MILLBANK
		NEW HAMBURG
		PETERSBURG
		PLATTSVILLE
		PRINCETON
		ST AGATHA
		ST CLEMENTS
		ST JACOBS
		TAVISTOCK
		WALLENSTEIN
		WATERLOO
		WELLESLEY
		WEST MONTROSE
OWEN SOUND		CHATSWORTH
		CLARKSBURG
		DUNDALK
		FLESHERTON
		HOLSTEIN
		MARKDALE
		MEAFORD
		OWEN SOUND
		PROTON STN
		THORNBURY

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OWEN SOUND	(CONT)	WASAGA BEACH
BRAMPTON		BRAMPTON GEORGETOWN GLEN WILLIAMS HUTTONVILLE LONGFORD ML NORVAL SNELGROVE TERRA COTTA
GUELPH		ABERFOYLE ALMA ARISS ARTHUR BALLINAFAD DRAYTON ELORA ERIN FERGUS GUELPH HARRISTON MARYHILL MOOREFIELD MORRISTON MOUNT FOREST PALMERSTON PUSLINCH WELLINGTON
BROCKVILLE		ATHENS BROCKVILLE DELTA FRASERVILLE GANANOQUE MAITLAND MALLORYTOWN

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
BROCKVILLE	(CONT)	PRESCOTT
		SPENCERVILLE
		WESTPORT
COBOURG		BALTIMORE
		COBOURG
		COLBORNE
		CREIGHTON MN
		GORES LANDING
		GRAFTON
		NEWTONVILLE
		PORT HOPE
OSHAWA		AJAX
		ASHBURN
		BLACKSTOCK
		BOND HEAD
		BOWMANVILLE
		BROOKLIN
		CLAREMONT
		DUNBARTON
		ENNISKILLEN
		GREENWOOD
		HAMPTON
		NEWCASTLE
		ORONO
		OSHAWA
		PICKERING
		PORT PERRY
		WHITBY
ORANGEVILLE		ALTON
		CALEDON
		CALEDON EAST
		CHELTENHAM
		GRAND VALLEY
		INGLEWOOD

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
ORANGEVILLE	(CONT)	MONO MILLS
		ORANGEVILLE
		PALGRAVE
		TOTTENHAM
STRATFORD		BORNHOLM
		BRUNNER
		BRUSSELS
		DUBLIN
		GADS HL STN
		HICKSON
		LISTOWEL
		MILVERTON
		MITCHELL
		NEWTON
		SEBRINGVILLE
		ST MARYS
		STRATFORD
LONDON		AILSA CRAIG
		ARVA
		BROWNSVILLE
		BURGESSVILLE
		COURTLAND
		CULLODEN
		DELAWARE
		DELHI
		DENFIELD
		DORCHESTER
		EMBRO
		EXETER
		FINGAL
		GLANWORTH
		GLENCOE
		HURON PARK
		HYDE PARK
		ILDERTON
		KERWOOD

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
LONDON	(CONT)	KINTORE
		KOMOKA
		LAMBETH
		LONDON
		LUCAN
		MELBOURNE
		METCALFE
		MOSSLEY
		MOUNT BRYDGES
		PARKHILL
		PORT STANLEY
		SALFORD
		SHARON
		STRATHROY
		THORNDALE
		WARDSVILLE
N. BAY		BONFIELD
		CALLANDER
		CAMERON
		EAU CLAIRE
		FIELD
		LAVIGNE
		NORTH BAY
		POWASSAN
		STURGEON FL
		VERNER
SAU ST MARIE		BATCHAWANA
		BLIND RIVER
		BRUCE MINES
		ECHO BAY
		ELLIOT LAKE
		HILTON
		S S MARIE
		THESSALON

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
SUDBURY	ALBAN
	AZILDA
	CAPREOL
	CHAPLEAU
	CONISTON
	COPPER CLIFF
	DOWLING
	ESPANOLA
	ESTAIRE
	FALCONBRIDGE
	HAGAR
	LEVACK
	LIVELY
	MASSEY
	MONETVILLE
	NAIRN CENTRE
	NOELVILLE
	ONAPING
	RIVER VALLEY
	ST CHARLES
	SUDBURY
	VAL CARON
	WAHNAPITAE
	WARREN
	WEBBWOOD
	WHITEFISH
THUNDER BAY	BEARDMORE
	GERALDTON
	LONGLAC
	MANITOUWADGE
	MARATHON
	RED ROCK
	TERRACE BAY
	THUNDER BAY

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
GRIMSBY	BEAMSVILLE
	GRASSIE
	GRIMSBY
	SMITHVILLE
	VINELAND
	WINONA
WOODSTOCK	INGERSOLL
	LAKESIDE
	MOUNT ELGIN
	NORWICH
	OTTERVILLE
	THAMESFORD
	TILLSONBURG
	WOODSTOCK
DUNNVILLE	DUNNVILLE
	LOWBANKS
	ST ANNS
	WELLANDPORT
WALKERTON	AYTON
	CARGILL
	CHEPSTOW
	CHESLEY
	CLIFFORD
	DURHAM
	EDEN
	ELMWOOD
	FORMOSA
	HANOVER
	MILDMAY
	NEUSTADT
	TEESWATER
	VARNEY

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
WALKERTON	(CONT)	WALKERTON
ST THOMAS		AYLMER AYLMER WEST BEACHVILLE BELMONT DUTTON PORT BRUCE PORT BURWELL RODNEY SOUTHWOLD SPRINGFIELD ST THOMAS WEST LORNE
KIRKLAND LAKE		BELLE VALLEE COBALT ENGLEHART HAILEYBURY KEARNS KIRKLAND LAKE LATCHFORD MATACHEWAN NEW LISKEARD SWASTIKA THORNLOE
SIMCOE		JARVIS NANTICOKE PORT DOVER SIMCOE TURKEY POINT VITTORIA WATERFORD

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
LINDSAY	BOBCAYGEON
	CANNINGTON
	FENELON FALLS
	JANETVILLE
	LINDSAY
	MANILLA
	OAKWOOD
	OMEMEE
	WOODVILLE
OTHER - NW	ARDOCH
	ARMSTRG-STN
	ATIKOKAN
	BARWICK
	BIG-TROUT-L
	CALSTOCK
	CENTRAL PAT
	CLEARWATER B
	COCHENOUR
	DESBARATS
	DEVLIN
	DINORWIC
	DORION
	DRYDEN
	DUBREUILVILLE
	DYMENT
	EAR FALLS
	EARLTON
	ELK LAKE
	EMO
	FOLEYET
	FOOTES BAY
	FORT FRANCES
	GARSON MINES
	GOGAMA
	GOULAIS RIVER
	HALLEBOURG

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - NW	(CONT)	HANMER
		HARTY
		HEARST
		HORNEPAYNE
		HUDSON
		IGNACE
		IRON BRIDGE
		KAGEWONG
		KAKABEKA FL
		KEEWATIN
		KENOGAMI LAKE
		KENORA
		LARDER LAKE
		MARTEN RIVER
		MATHESON
		MATTICE
		MINAKI
		MOOSONEE
		MORSON
		MURILLO
		NAKINA
		NESTOR FALLS
		NIPIGON
		NIPISSG-JCT
		NORTH COBALT
		OPASATIKA
		OTHER - NW
		OXDRIFT
		PASS LAKE
		RAINY RIVER
		RED LAKE
		ROSSPORT
		SCHREIBER
		SHEBANDOWAN
		SIOUX LOOKOUT
		SIOUX NARROWS
		SLEEMAN
		STRATTON
		UPSALA
		VERMILION BAY

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
OTHER - NW (CONT)	WAWA
	WHITE RIVER
PETERBOROUGH	BETHANY
	BEWDLEY
	BLEZARD VLY
	BRIDGENORTH
	BURLEIGH FL
	CAMPBELLCROFT
	CASTLETON
	CAVAN
	DUNSFORD
	ENNISMORE
	HAVELOCK
	KEENE
	LAKEFIELD
	MILLBROOK
	NORWOOD
	PETERBOROUGH
	PONTYPOOL
	YOUNGS POINT
COCHRANE	COCHRANE
	CONNAUGHT
	IROQUOIS FL
	KAPUSKASING
	MONTEITH
	MOONBEAM
	PORCUPINE
	PORQUIS JCT
	SCHUMACHER
	SMOOTH-ROCK
	TIMMINS
	VAL RITA

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
BRANTFORD	BRANTFORD
	BURFORD
	CATHCART
	JERSEYVILLE
	LYNDEN
	MT PLEASANT
	PARIS
	SCOTLAND
	ST GEORGE
	TROY
OTHER - S CENTRAL	ALGOMA MILLS
	AMELIASBURG
	ANNAN
	APSLEY
	ARDEN
	ATHERLEY
	BAILIEBORO
	BALM BEACH
	BANNOCKBURN
	BARRYS BAY
	BELWOOD
	BIRDS CREEK
	BOLSOVER
	BRECHIN
	BRIDGEPORT
	BUCKHORN
	CAMDEN EAST
	CANNIFTON
	CHAFFEY LOCKS
	CHERRY VALLEY
	CLOYNE
	COBOCONK
	DENBIGH
	ELDORADO
	ENTERPRISE
	EVERETT

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
OTHER - S CENTRAL (CONT)	FISHERVILLE
	GILMOUR
	GLEN HURON
	GLEN MEYER
	GODERICH
	GOLDEN LAKE
	GOODERHAM
	GOWANSTOWN
	GUNTER
	HAGERSVILLE
	HALIBURTON
	HARLEY
	HARWOOD
	HEATHCOTE
	HILLIER
	HILLSBURGH
	HLAND-GROVE
	HONEY HARBOUR
	HONEYWOOD
	JACKSONS P
	KALADAR
	KEMBLE
	KENDAL
	KENILWORTH
	KILLALOE STN
	KILWORTHY
	KINMOUNT
	KIRKFIELD
	L AMABLE
	LAKEHURST
	LANGTON
	LAUREL
	LEFROY
	LISLE
	LORETTO
	LTL BRITAIN
	MACTIER
	MADAWASKA
	MANSFIELD
	MAPLE LEAF

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - S CENTRAL	(CONT)	MARLBANK
		MAXWELL
		MAYNOOTH
		MIDHURST
		MINDEN
		MTN GROVE
		NESTLTN-STN
		NEW DUNDEE
		NEWBURGH
		NORLAND
		OTHER - S CEN
		PALMER RAPIDS
		PENETANG
		PERKINSFIELD
		PHELPSTON
		PICTON
		PLEVNA
		PORT BOLSTER
		PORT MCNICOLL
		PORT ROWAN
		PORT SEVERN
		PORT SYDNEY
		PORT UNION
		PRICEVILLE
		PRINCE ALBERT
		PT SANDFIELD
		QUADEVILLE
		RIDGEVILLE
		ROCKTON
		ROSEMONT
		ROSENEATH
		ROUND L CTR
		SALEM
		SEAGRAVE
		SEBRIGHT
		SELKIRK
		SEVERN BRIDGE
		SHALLOW LAKE
		SHANTY BAY
		SHEFFIELD

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - S CENTRAL	(CONT)	SHELBURNE
		SINGHAMPTON
		SPRINGFORD
		TAMWORTH
		THOMASBURG
		TRENT RIVER
		UDNEY
		WALTERS FALLS
		WASHAGO
		WAUBAUSHENE
		WELCOME
		WELLAND JCT
		WEST GUILFORD
		WILBERFORCE
		WILLIAMSFORD
		WILNO
		WILSONVILLE
		WINDERMERE
		WOOLER
		WYEVALE
		YARKER
HUNTSVILLE		BAYSVILLE
		BRACEBRIDGE
		DWIGHT
		EMSDALE
		GRAVENHURST
		HUNTSVILLE
		NOVAR
		PORT CARLING
		SPRUCEDALE
		UTTERSON
OTHER - SE		ALFRED
		ARNPRIOR
		ASHTON
		AVONMORE
		BALDERSON

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - SE	(CONT)	BEACHBURG
		BRAESIDE
		BRINSTON
		BURNSTOWN
		CALABOGIE
		CEDAR SPRINGS
		CENTRALIA
		CHU-BLONDAU
		CLAYTON
		COBDEN
		CURRAN
		DACRE
		DALKEITH
		DOUGLAS
		EGANVILLE
		ELGIN
		FORESTER FL
		FOURNIER
		GL ROBRTSON
		GODFREY
		GREELY
		GREEN VALLEY
		HALEYS STN
		HAMMOND
		JASPER
		LANSDOWNE
		LEFAIVRE
		LOMBARDY
		LYN
		LYNDHURST
		MABERLY
		MCDONLD-COR
		MONKLAND
		MOREWOOD
		MOUNTAIN
		NAPANEE
		NAVAN
		OSGODE STN
		OTHER - SE
		PARHAM

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - SE	(CONT)	PEMBROKE
		PERTH ROAD
		PETAWAWA
		RENFREW
		RICHMOND
		RIDEAU FERRY
		ROCKPORT
		SARSFIELD
		SHARBOT LAKE
		ST ANDREWS
		ST BERNARDIN
		STROUD
		SUMMERSTOWN
		VARS
		VERONA
		VIENNA
		WHITE LAKE
OTHER - SW		ALLANFORD
		ANGUS
		APPIN
		ATWOOD
		BELGRAVE
		BLUEVALE
		BLYTH
		BRODHAGEN
		BRUCEFIELD
		CLINTON
		CREDITON
		CROTON
		DASHWOOD
		DOVER CENTRE
		DUNGANNON
		EDYS MILLS
		FORDWICH
		GORRIE
		GRANDE POINTE
		HENSALL
		HOLYROOD

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - SW	(CONT)	IONA STATION
		KENTBRIDGE
		KINBURN
		KINCARDINE
		KIPPEN
		KIRKTON
		LA SALETTE
		LA SALLE
		LUCKNOW
		MERLIN
		MONKTON
		MORPETH
		MUNCEY
		NEWBURY
		OTHER - SW
		PAINCOURT
		PAISLEY
		PORT ELGIN
		PORT FRANKS
		PUTNAM
		RIPLEY
		SAUBLE BEACH
		SEAFORTH
		SHEDDEN
		SOUTHAMPTON
		ST WILLIAMS
		STAFFA
		STAPLES
		STRAFFORDV
		TALBOTV-RYL
		TARA
		TEETERVILLE
		TIVERTON
		TOBERMORY
		TUPPERVILLE
		VARNA
		WALLACETOWN
		WALTON
		WIARTON
		WINDHAM CTR

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA		CONSTITUENT MUN.
OTHER - SW	(CONT)	WINGHAM
		WOODHAM
		WROXETER
		YORK
		ZURICH
ST CATHARINES		ALLANBURG
		CHELMSFORD
		CLARENCE CK
		JORDAN STN
		NIAGARA FALLS
		NIAGARA/L
		QUEENSTON
		ST CATHARINES
		ST DAVIDS
		THOROLD
		VIRGIL
OTHER - NE & CENTRAL		AHMIC HARBOUR
		ASTORVILLE
		BAYFIELD
		BELLE EWART
		BRITT
		BURKS FALLS
		CAESAREA
		CHALK RIVER
		CHERRYWOOD
		COATSWORTH
		COE HILL
		CORBEIL
		DEEP RIVER
		DESBORO
		DORSET
		DUNCHURCH
		EDWARDS
		EXCELSIOR
		FLETCHER
		GLENCAIRN

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
OTHER - NE & CENTRAL (CONT)	GORE BAY
	GOULAIS BAY
	HANNON
	HARCOURT
	HARDWOOD LAKE
	HARLEM
	HAWK JUNCTION
	HOYLE
	INDIAN RIVER
	INVERARY
	KAMINISTIKWIA
	KEARNEY
	KILLARNEY
	KIOSK
	KORMAK
	LIONS HEAD
	LOCUST HILL
	LTL CURRENT
	LUNENBURG
	MAGNETAWAN
	MANITOWANING
	MAR
	MATTAWA
	MCGREGOR
	MELDRUM BAY
	MINDEMOYA
	NIPISSING
	NOBEL
	NOLALU
	OTHER - NE
	P BARIL
	PARRY SOUND
	PICKEREL R
	PORT LORING
	RAMA ROAD
	RAMSAYVILLE
	REDBRIDGE
	RICHARDS LDG
	ROSSEAU
	RUTHERGLEN

LISTING OF MUNICIPAL AREAS

MUNICIPAL AREA	CONSTITUENT MUN.
OTHER - NE & CENTRAL (CONT)	RYDAL BANK
	S MONAGHAN
	S MOUNTAIN
	S PORCUPINE
	S WOODSLEE
	SANS SOUCI
	SEARCHMONT
	SHEGUIANDAH
	SHERKSTON
	SILVER WATER
	SOUTH RIVER
	SPANISH
	SPRAGGE
	SPRING BAY
	STRATHCONA
	STRICKLAND
	SUNDRIDGE
	TEMAGAMI
	TROUT CREEK
	WABIGOON
	WALFORD STN
	WHITEFISH FL
	WHITNEY
	WIKWEMIKONG

POOR
QUALITY
ORIGINAL